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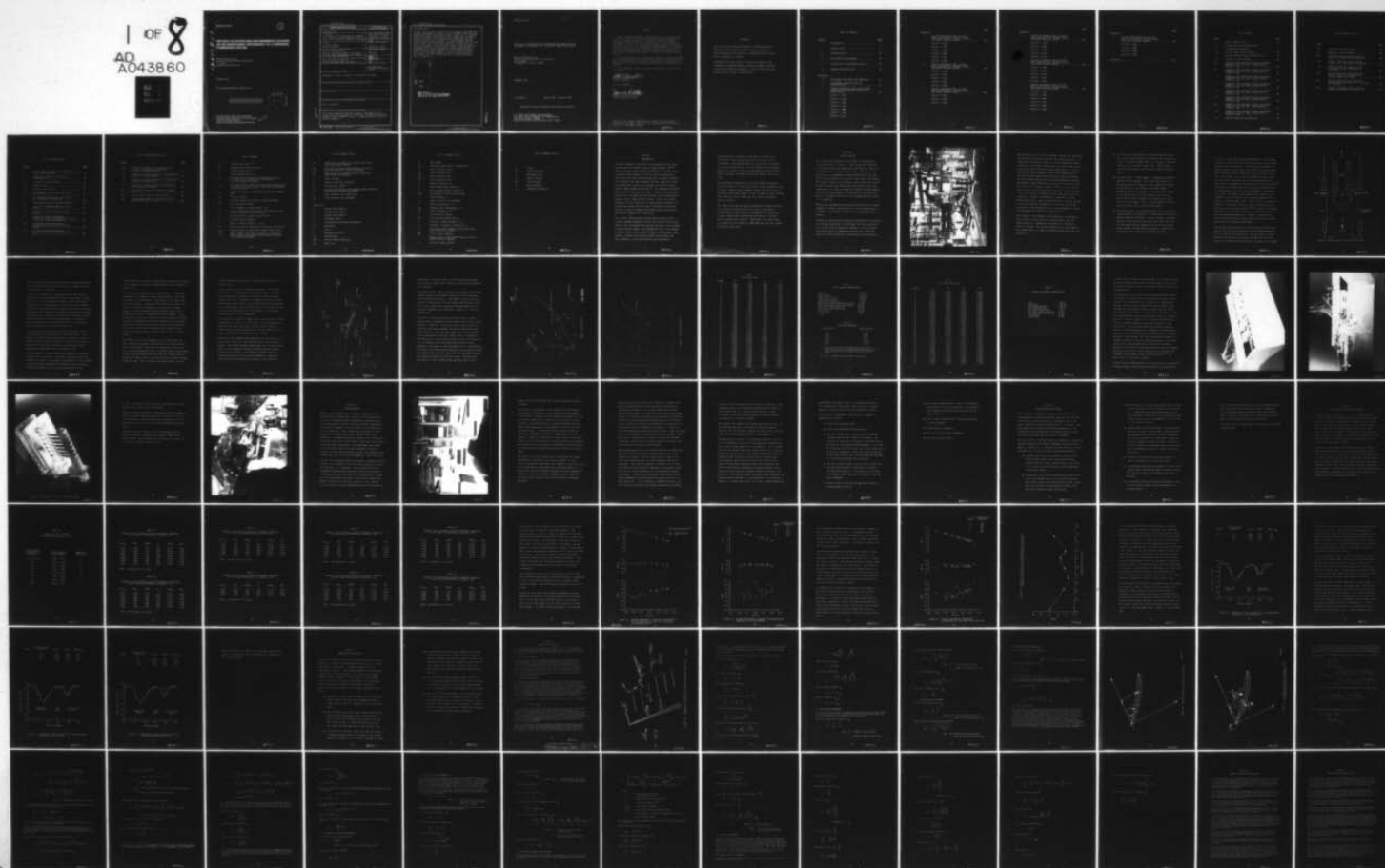
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THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AERODYNAMIC PERFORMANCE OF A SUPERSONIC COMPRESSOR CASCADE

DETROIT DIESEL ALLISON
DIVISION OF GENERAL MOTORS CORPORATION
P. O. BOX 894
INDIANAPOLIS, INDIANA 46206

FEBRUARY 1977

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AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
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Previous experimental studies of this cascade showed that the cascade performance concurred with the modeled rotor data and that the splitter vane location and/or shape was not optimal. Hence, the overall objective of this program was to experimentally determine if a preferred circumferential position for the splitter vane existed. This was accomplished by modifying the original cascade hardware to permit the splitter vanes to be moved in the equivalent circumferential direction with respect to the principal blades. The aerodynamic characteristics of the cascade were then experimentally determined at 41 test conditions. These covered a range of static pressure ratios between 1.6 and the spill point at the design inlet Mach number, for each of eight splitter vane locations, one of which was the original 50 percent spacing location.

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Division of General Motors Corporation
P.O. Box 894
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Final Report

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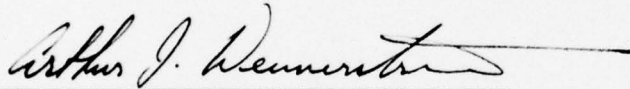
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This technical report has been reviewed and is approved for publication.



ARTHUR J. WENNERSTROM
Project Engineer

FOR THE COMMANDER



JAMES L. RADLOFF, Major, USAF
Chief, Components Branch
Turbine Engine Division

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PREFACE

This report was prepared by Ronald E. Riffel and Sanford Fleeter of the Aerothermodynamics Research Department, Detroit Diesel Allison, Division of General Motors Corporation, Indianapolis, Indiana.

Presented herein are results of the work conducted under Contract No. F33615-76-C-2052, Project No. 2307, sponsored by the Aero-Propulsion Laboratory. The Air Force contract monitor was Dr. Arthur J. Wennerstrom.

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	P)2/P)1 = 1.635	
	P)2/P)1 = 1.686	
	P)2/P)1 = 1.752	
	P)2/P)1 = 1.880	
	P)2/P)1 = 1.949	
	P)2/P)1 = 2.011	

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	P)2/P)1 = 1.750	
	P)2/P)1 = 1.818	
	P)2/P)1 = 1.894	
	P)2/P)1 = 1.941	
	P)2/P)1 = 1.995	
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	P)2/P)1 = 1.794	
	P)2/P)1 = 1.848	
	P)2/P)1 = 1.895	
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	P)2/P)1 = 1.965	

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	P)2/P)1 = 1.718	
	P)2/P)1 = 1.786	
	P)2/P)1 = 1.836	
	P)2/P)1 = 1.964	
	P)2/P)1 = 2.013	
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	P)2/P)1 = 1.707	
	P)2/P)1 = 1.790	
	P)2/P)1 = 1.856	
	P)2/P)1 = 1.917	
	P)2/P)1 = 1.956	
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P)2/P)1 = 1.593

P)2/P)1 = 1.844

P)2/P)1 = 1.984

P)2/P)1 = 2.057

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LIST OF SYMBOLS

A	Cascade flow area, in ²
A _S	Cascade blade surface area, in ²
B	Cascade blade span, in.
C	Cascade blade chord, in.
C _D	Drag coefficient (drag force referenced parallel to blade chord normalized by inlet dynamic pressure, span, and chord)
C _L	Lift coefficient (lift force referenced perpendicular to blade chord normalized by inlet dynamic pressure, span, and chord)
C _p	Center of pressure, percent chord from blade leading edge
D _f	Diffusion factor
f _i	Discrete cascade exit data to be mass-averaged
<f>	Mass averaged variable
F	Force exerted on cascade blades, lbs
F _C	Forced coefficient (blade force normalized by inlet dynamic pressure, span, and chord)
g	Gravitational constant, 32.175 ft/sec ²
i	Incidence angle, degrees
k	Ratio of specific heats, k = 1.4
m	Mass flow rate per passage per inch span, lbs/sec-in.
M _{LE}	Moment exerted on blade about leading edge, lb-in.
M _{C_{LE}}	Moment coefficient (moment exerted on blade about leading edge normalized by inlet dynamic pressure, span, and chord squared)

LIST OF SYMBOLS (Cont.)

Δ	Compression or expansion of nozzle flow field by cascade wedge, degrees
θ_{TS}	Test section angle, angle between wind tunnel axis and tangential direction, degrees
θ_w	Wedge angle, angle between wedge surface and axial direction, degrees
κ	Angle, degrees
μ	Dynamic viscosity, lb/sec-ft.
ρ	Flow density, lb/ft ³
ψ_p	Conical probe angle, angle between probe centerline and tangential direction, degrees
ω	Total pressure loss coefficient
ω_p	Total pressure loss parameter

Subscripts:

0	Nozzle exit condition
1	Cascade inlet station
2	Cascade exit station
A	Arithmetic mean
C	Calculated from continuity equation
eq	Equivalent
F	Force
i	Reference position
LE	Leading edge
LEN	Airfoil leading edge nose
ML	Mean line

LIST OF SYMBOLS (Cont.)

M_n	Mach number
N_R	Reynolds number based on blade chord
P	Static pressure, psia
P_R	Static pressure ratio
P_{R_T}	Total pressure ratio
P_T	Total pressure, psia
Q	Dynamic pressure, psi
r	Blade leading edge radius, in.
R	Gas constant, 53.34 ft-lb/lb-°R
RMS	RMS deviation from the mean value
s	Blade spacing, in.
S	Static pressure rise parameter
T	Static temperature, °R
T_{AD}	Adiabatic wall temperature, °R
T_T	Total temperature, °R
V	Flow velocity, ft/sec
ΔV	Flow velocity change, ft/sec
X	Distance in axial direction, in.
Y	Distance in tangential direction, in.
β	Flow angle, angle between flow velocity and axial direction, degrees
$\Delta\beta$	Turning angle, degrees
γ	Stagger angle, angle between blade chord and axial direction, degrees
δ°	Deviation angle, degrees

LIST OF SYMBOLS (Cont.)

P	Probe
PS	Pressure surface
R	Resultant force
SS	Suction surface
TE	Trailing edge
X	Axial direction
Y	Tangential direction

SECTION I

INTRODUCTION

An axial compressor rotor which incorporated splitter vanes was designed and tested by the Aerospace Research Lab⁽¹⁾. The test results were unusually successful. Following this, a selected blade element from this rotor was modeled by a two-dimensional rectilinear cascade with converged sidewalls. This cascade, which had rotatable splitter vanes at a fixed circumferential location, was tested in the Detroit Diesel Allison (DDA) cascade facility^(2,3). The cascade performance data concurred with the rotor data. However, these cascade results also indicated that the splitter vane circumferential location and/or shape was not optimal. Hence, the overall objective of this program was to experimentally determine if a preferred cascade splitter vane circumferential position existed in terms of blade surface Mach number distributions and overall cascade loss coefficient.

This overall objective was accomplished by modifying the original cascade hardware to permit the splitter vanes to be moved in the circumferential equivalent direction with respect to the principal blades. The cascade was fully instrumented including static pressure taps (sidewall interpassage, blade surface, splitter vane surface, blade trailing edge, and exit sidewall), inlet total pressure and temperature

instrumentation, traversing cone probe in the exit flow field, test section angular position and probe position transducers. Experimental data from all of the instrumentation were obtained with an on-line computer controlled data acquisition system. Schlieren photography was also used to obtain important information about the cascade inlet conditions.

The aerodynamic characteristics of the cascade were determined at a total of 41 test conditions. These included a range of static pressure ratios between 1.6 and the spill point at the design inlet Mach number of 1.46 for each of eight splitter vane locations, one of which was the original 50 percent spacing location.

This report describes the above experimental research program and includes information about the final cascade design, instrumentation, data reduction procedures, and cascade performance results which demonstrate the effect of splitter vane circumferential location. Appendices cover data reduction equations, the format for each data set, and the cascade performance data sets.

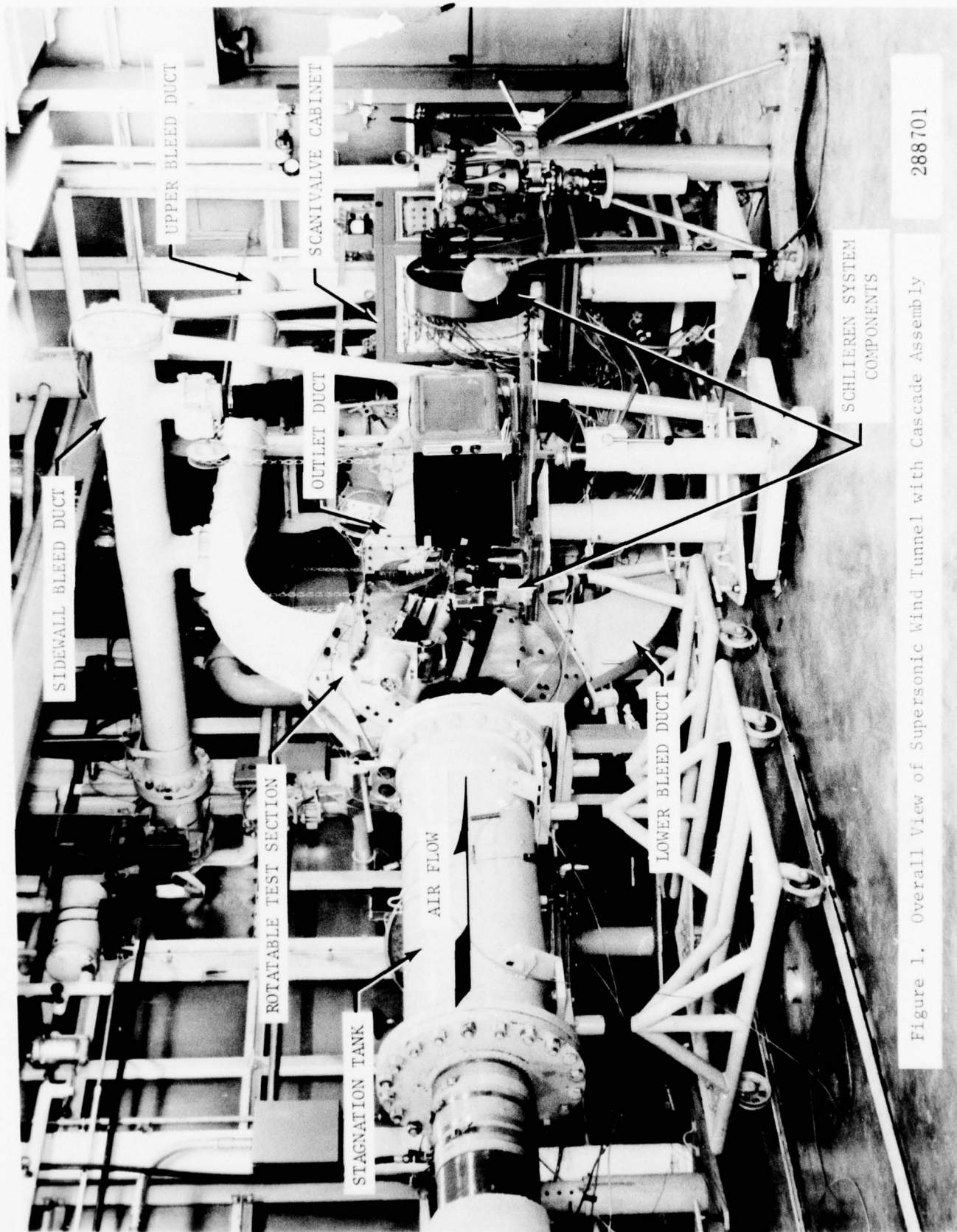
SECTION II

CASCADE DESIGN

The cascade was designed to be operated in the supersonic wind tunnel shown in Figure 1. This tunnel uses 10 lb/sec of filtered, dried, and temperature controlled air and is a continuous flow, non-return type system. The exit of the test section is evacuated by steam ejectors which can maintain an exit pressure of 6 psia at a flow rate of 10 lb/sec. The boundary layers from the fixed nozzle blocks are removed through the upper and lower bleed ducts while an auxiliary steam ejector is used to remove the sidewall boundary layers. The facility also features a mechanized test section which permits a cascade of airfoils to be rotated while the tunnel is in operation.

Although the cascade was designed during a previous contract (F33615-71-C-1766), some discussion of the cascade design is included in this report for the sake of completeness and clarity.

A number of general factors should be considered in the design of a cascade experiment to investigate the flow characteristics of this type of compressor blading. First, consideration must be given to establishing the proper inlet flow conditions with the desired inlet velocity, flow direction,



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Figure 1. Overall View of Supersonic Wind Tunnel with Cascade Assembly

and simulation of an infinite cascade. Second, the philosophy employed during the design of the rotor blading results in a large area convergence in the rotor and a substantial amount of turning. This type of design does not lend itself to the conventional two-dimensional cascade experiment. In order to simulate the blade passage and exit flow characteristics, the experimental cascade must provide for area convergence. This was accomplished by using contoured sidewalls; however, the boundary layer characteristics along the contoured sidewalls must be considered in detail. Third, the exit conditions must be set up correctly for they are no less important, or less difficult to simulate properly, than the inlet flow conditions. Another consideration of importance is the blade aspect ratio. Lastly, the experiment should be designed to yield the desired information in its final form at the conclusion of the experiment, i.e., with parameters of interest calculated and, where desirable, plotted.

With respect to the cascade inlet conditions, consideration must be given to flow velocity, flow direction, and the establishment of a repeating flow pattern to simulate an infinite cascade. The following features are incorporated in the cascade design in order to provide the desired inlet flow conditions.

- Top and bottom bleed system. The bleed system prevents the nozzle boundary layers from entering the cascade flow field. They also provide paths for spillage so that back pressure will not affect nozzle flow. Additionally, critical flow problems are avoided in rotating the cascade.
- Upstream wedge. A sharp wedge is independently mounted upstream of the cascade. The inlet flow direction is determined by the orientation of the wedge with respect to the airfoils. The cascade inlet Mach number is determined by the orientation of the wedge with respect to the nozzle flow, with the cascade inlet velocity controlled by either expanding or shocking the nozzle flow off of the wedge. This is accomplished by rotating the test section with respect to the nozzle.
- Schlieren system. An important aspect of the inlet flow field problem is the ability to verify that the conditions desired have been achieved. For this purpose a schlieren system is used to verify the inlet flow field, the flow off the wedge, and the operation of the top and bottom bleed system. It also can be employed to indicate when the cascade spill conditions have been reached.

In order to obtain the desired distribution of stream-tube convergence and/or axial velocity-density ratio, the cascade sidewalls must be contoured. The presence of sidewalls as well as blade boundary layers will alter the imposed stream-tube convergence and an "effective" axial velocity density-ratio will result. The control of sidewall boundary layers on stream-tube convergence was first evaluated theoretically, and is discussed at some length in a previous report⁽⁴⁾. The analyses indicated that for this type of experiment, it was advantageous to use the slot configuration illustrated in Figure 2. Evaluating the boundary layer growth on the sidewalls along the length of the nozzles yielded a δ^* of 0.055 in. at the cascade inlet. Based on this, a bleed slot thickness of 0.075 was selected. This slot thickness was used during the original program^(2,3,4) at which time surface parameters, such as static pressure and wall shear stress were evaluated experimentally. Because of the excellent theoretical/experimental results, this slot width was maintained during the present experiment.

The cascade must be designed so that the exit will have the correct velocity and flow direction and be characterized by periodic spatial flow conditions. The application of back pressure must be uniform along the cascade and should not result in nonperiodic flow conditions. Moreover, the cascade

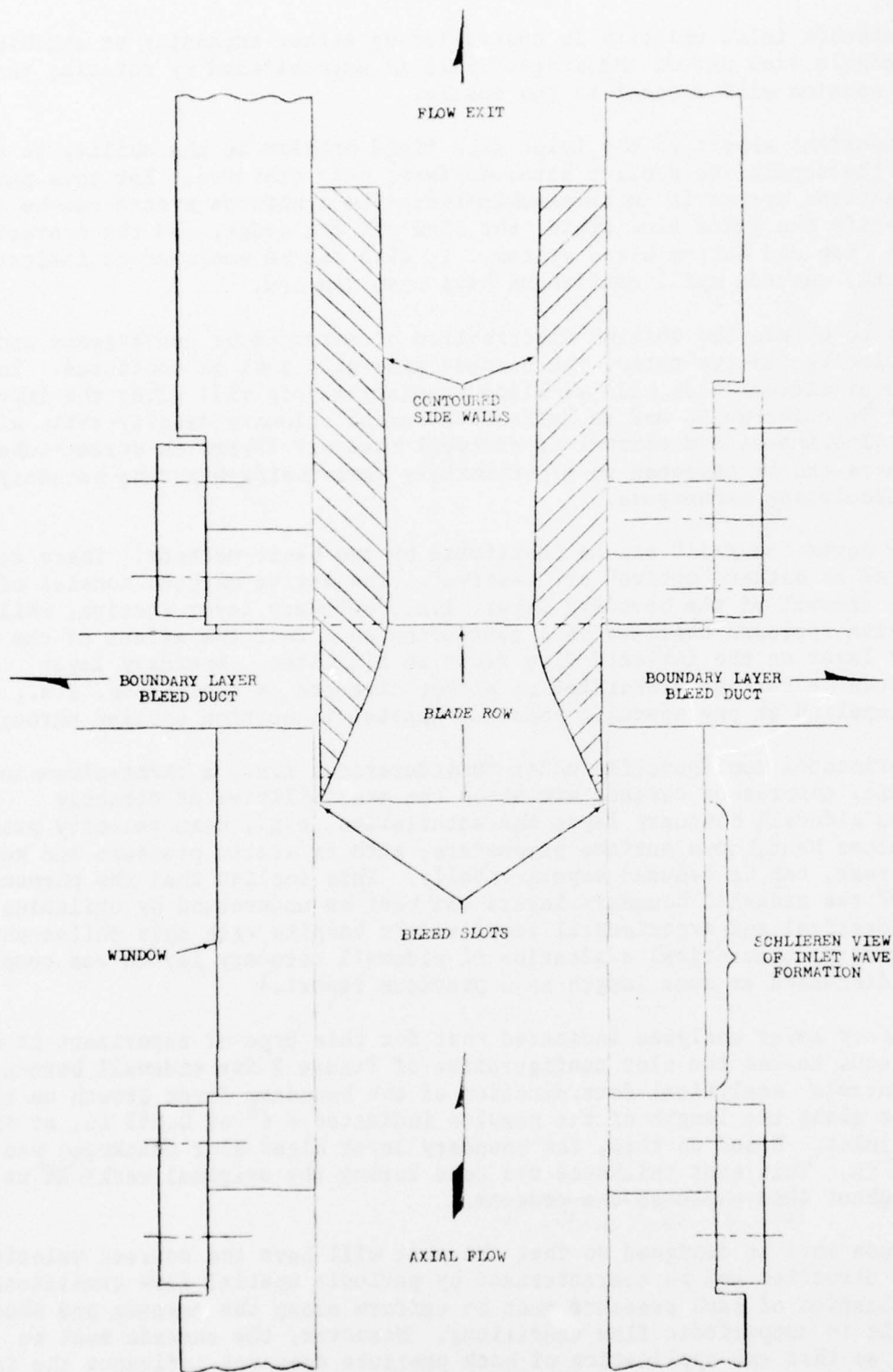


Figure 2. Compressor Cascade Cross Section in Axial Plane

must be designed so that the application of back pressure does not influence the inlet flow conditions -- at least until the spill condition is reached.

A number of cascade exit configurations have been investigated with the DDA wind tunnel facility. These have included the use of single perforated tailboards, double perforated tailboards, and a dump diffuser. It has been found that the cascade design objectives with respect to the exit flow can be achieved through the use of a carefully designed dump diffuser. Best results are obtained if the diffuser is designed so that both end blades have fully developed wakes. Care must be exercised, however, to insure that there is no intercommunication between the inlet and exit flow fields.

In designing a two-dimensional compressor cascade, a factor of significance to be considered is the aspect ratio. The question of aspect ratio always arises in regard to the two dimensionality of the flow field. In the past, when testing subsonic two-dimensional compressor cascades, the widely recommended aspect ratio was in the range of 3-5.

The development of the two dimensional supersonic compressor cascade with its very thin, low camber, low turning airfoils resulted in changes in the design considerations of the cascade. It was found that structural considerations were significant and that the questions of stress, blade deflection, and

flutter had to be resolved. These questions generally resulted in an acceptable value for the blade aspect ratio of approximately 1.0.

It is recognized that flow two dimensionality is intimately associated with sidewall boundary layer buildup. This fact was taken into consideration in the design of the DDA supersonic wind tunnel. In designing the supersonic nozzles, the choice of flexible or asymmetric nozzles was eliminated because of their characteristically greater length, which would have resulted in large boundary layer growth. Solid nozzle blocks were chosen because they are inherently shorter, further, the aerodynamic design was selected to minimize the supersonic length while maintaining uniform flow conditions. In the case of the Mach 1.5 nozzles, the length from the throat to the test section, which is 8.0 in. high, is only 10.65 in.

The effect of tunnel configuration on two dimensional subsonic compressor cascade characteristics was investigated by Erwin and Emery.⁽⁵⁾ Tests were run with aspect ratios from 1 to 4 and with different types of boundary layer bleed systems. It was found that essentially the same test results were obtained with aspect ratios of 1.0 and 4.0 when sidewall passage bleed was used. This indicates that aspect ratio is not of

primary importance provided the boundary layer thickness is insignificant.

In the present case, as discussed previously, a slot bleed at the start of the contoured sidewall was used. Therefore the boundary layer thickness at the start of the contoured sidewall was zero. In addition, computations have shown that the boundary layer growth on the sidewalls through the passage will be negligible. Thus an aspect ratio of one should result in minimal discrepancies and close simulation of quasi-two dimensional flow in this experiment.

The cascade consisted of 6 blades and 5 splitter vanes as shown schematically in Figure 3. The location of the wedge used to establish the inlet flow field and the cone probe used to measure the exit flow conditions with its tip 0.490 in. downstream axially from the cascade are also shown.

The windows and sidewalls were designed with the objective of maximizing visibility of the cascade inlet in the schlieren system. The windows extended downstream of the contoured sidewalls to avoid optical problems associated with the window-window frame interface. The blade tips extended 0.050 in. (axially) upstream of the contoured sidewalls so that the blade locations were established clearly in the schlieren

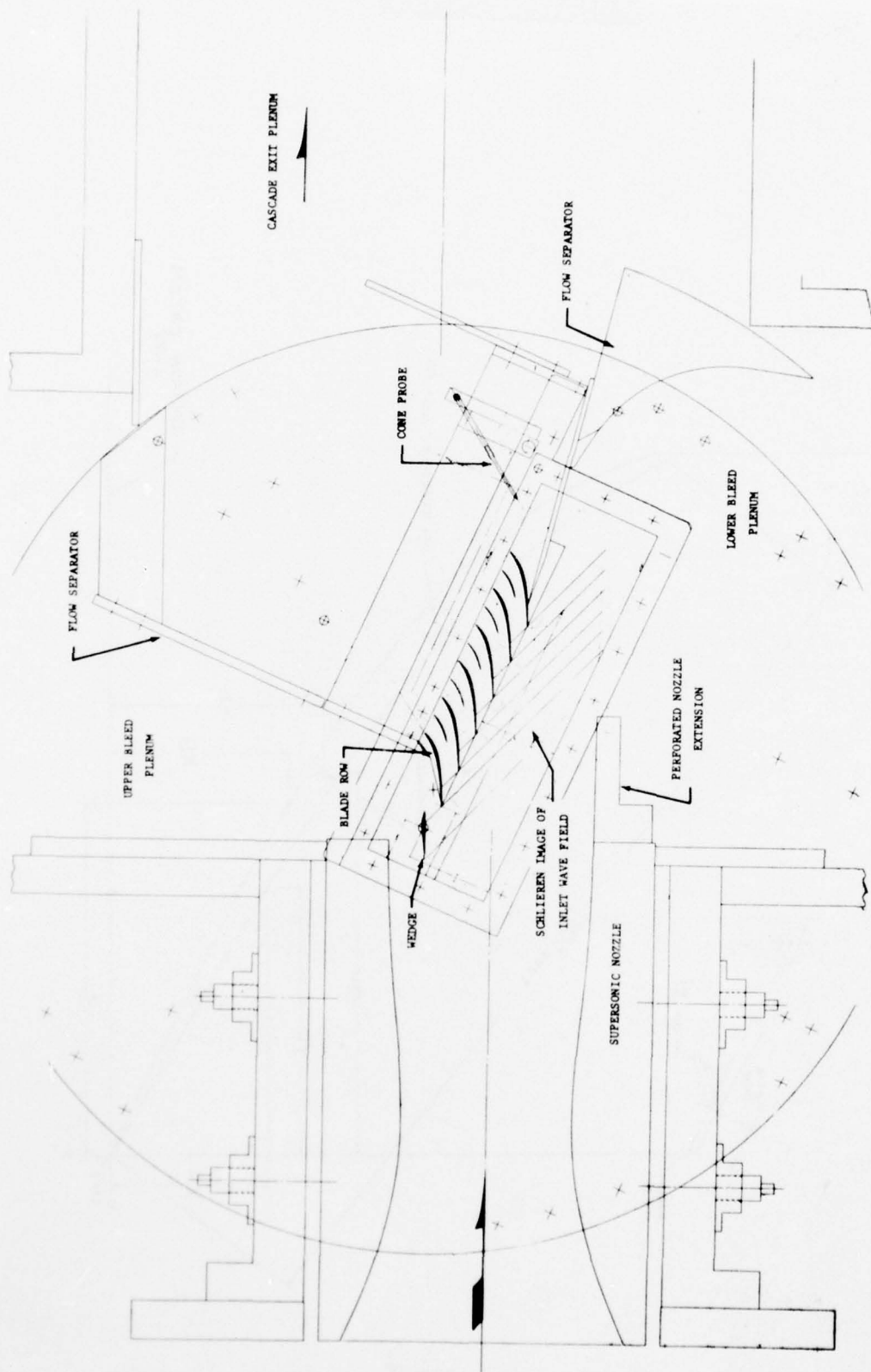


Figure 3. Compressor Cascade Schematic

photographs. The major parts of the top and bottom bleeds were visible so that proper operation could be confirmed with the schlieren.

The blade profile, shown in Figure 4, was based on the stream-surface geometry of streamline number 10 of the previously referenced ARL rotor design. The blade contour points, the physical characteristics of the cascade, and the axial variation in the stream-tube convergence, accomplished with the contoured sidewalls, are specified in Tables I, II, and III, respectively.

The profile of the ARL designed splitter vanes is shown in Figure 5 with a tabulation of the splitter vane contour points provided in Table IV. The splitter vanes were designed so that they would extend between the 50 and 100 percent axial chord locations. Also the mean camber line of the splitter vanes corresponded to the mean camber line of the blades in the same region. The thickness-to-chord ratio and the thickness distribution were consistent with the ARL criteria employed in the design of the comparable rotor. The thickness distribution was determined by designing an equivalent circular arc cascade blade with the same inlet and exit angles and the same maximum thickness as the rotor blade. The thickness distribution of this cascade blade was then used for the

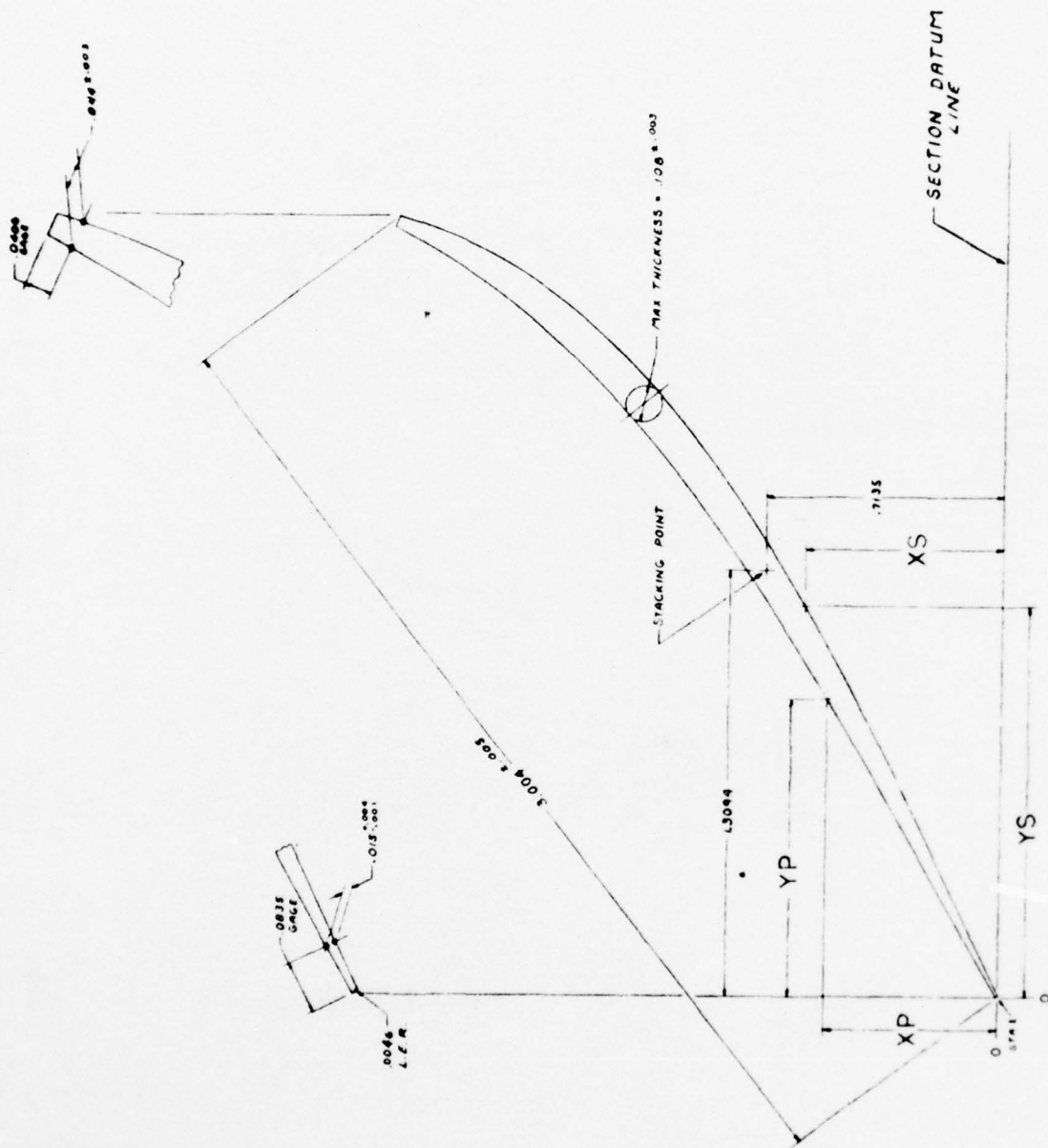


Figure 4. Blade Profile

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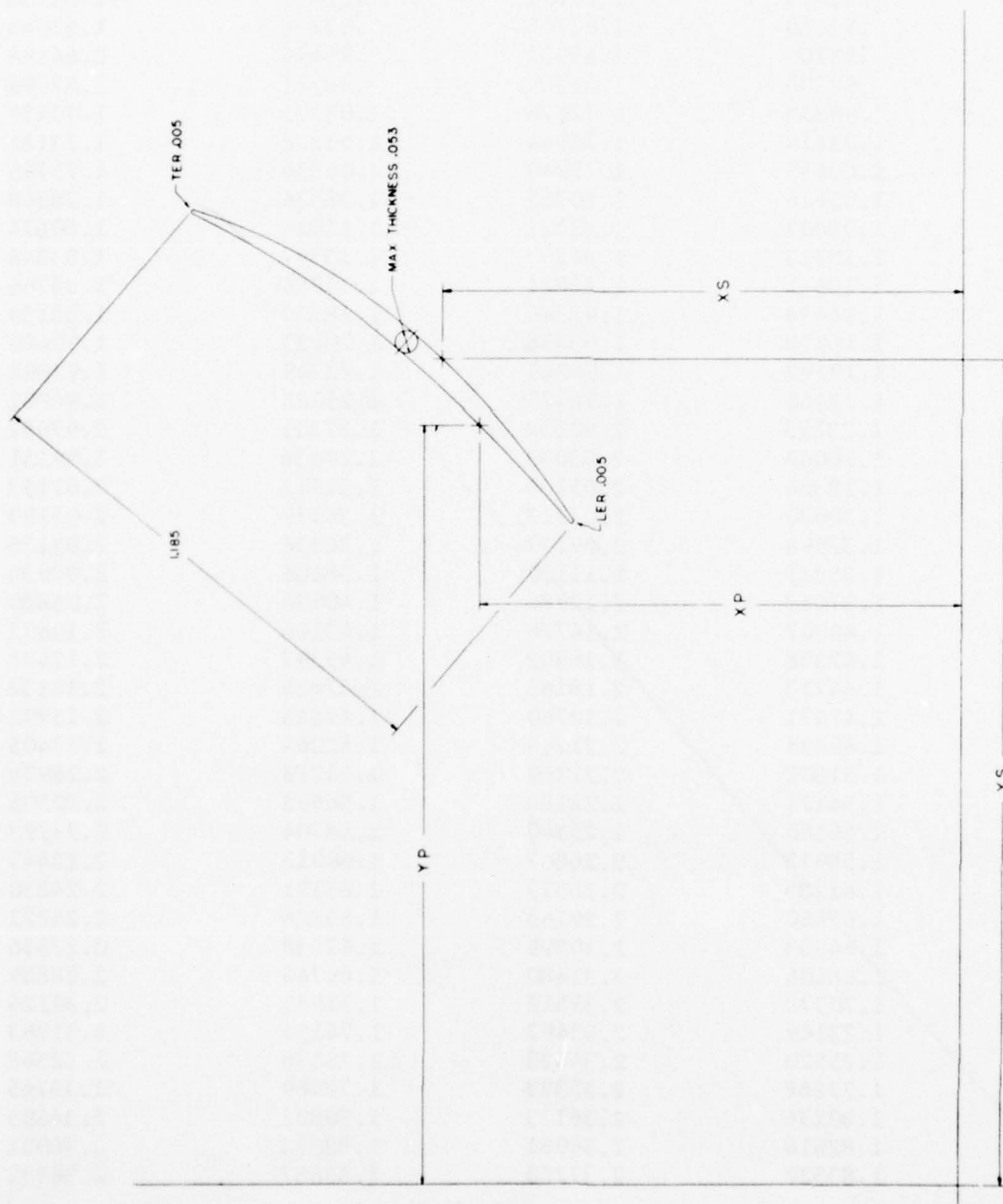


Figure 5. Splitter Vane Profile

TABLE I
BLADE CONTOUR POINTS

<u>STATION</u>	<u>XS</u>	<u>YS</u>	<u>XP</u>	<u>YP</u>
1	+.0005	+.0021	+.0087	-.0021
2	.0352	.0780	.0486	+.0713
3	.0700	.1538	.0885	.1445
4	.1047	.2294	.1284	.2175
5	.1395	.3047	.1682	.2902
6	.1744	.3796	.2079	.3625
7	.2093	.4539	.2476	.4342
8	.2443	.5276	.2873	.5054
9	.2793	.6006	.3268	.5758
10	.3145	.6728	.3663	.6455
11	.3498	.7442	.4056	.7143
12	.3852	.8146	.4449	.7821
13	.4207	.8839	.4840	.8490
14	.4563	.9522	.5229	.9148
15	.4921	1.0193	.5618	.9794
16	.5280	1.0851	.6005	1.0429
17	.5640	1.1497	.6391	1.1051
18	.6002	1.2130	.6775	1.1660
19	.6365	1.2748	.7158	1.2255
20	.6730	1.3352	.7540	1.2837
21	.7096	1.3942	.7920	1.3404
22	.7464	1.4516	.8298	1.3956
23	.7833	1.5075	.8675	1.4494
24	.8204	1.5618	.9051	1.5016
25	.8576	1.6145	.9425	1.5523
26	.8949	1.6656	.9797	1.6014
27	.9325	1.7150	1.0169	1.6490
28	.9701	1.7628	1.0538	1.6949
29	1.0078	1.8089	1.0907	1.7393
30	1.0457	1.8533	1.1274	1.7820
31	1.0838	1.8960	1.1640	1.8232
32	1.1219	1.9370	1.2005	1.8628
33	1.1602	1.9763	1.2368	1.9008
34	1.1986	2.0139	1.2730	1.9374
35	1.2372	2.0497	1.3090	1.9724
36	1.2759	2.0839	1.3449	2.0061
37	1.3148	2.1162	1.3807	2.0383
38	1.3538	2.1469	1.4163	2.0692
39	1.3929	2.1758	1.4518	2.0988
40	1.4321	2.2030	1.4872	2.1271
41	1.4714	2.2286	1.5225	2.1543
42	1.5108	2.2525	1.5578	2.1803
43	1.5502	2.2748	1.5930	2.2053
44	1.5897	2.2955	1.6282	2.2293
45	1.6291	2.3146	1.6634	2.2523
46	1.6685	2.3323	1.6985	2.2745
47	1.7079	2.3486	1.7338	2.2959
48	1.7473	2.3635	1.7690	2.3166
49	1.7866	2.3771	1.8043	2.3366
50	1.8259	2.3894	1.8397	2.3560

TABLE II
CASCADE PHYSICAL CHARACTERISTICS

Chord	3.004 in.
Axial Chord	1.8397 in.
Blade Spacing	1.5810 in.
Blade Span-Inlet Plane	2.861 in.
Blade Span-Exit Plane	1.477 in.
Max. Thickness/Chord Ratio	.03614
Metal Angle-Leading Edge Pressure Surface	61.417°
Metal Angle-Leading Edge Suction Surface	65.479°
Mean Camber Angle-Leading Edge	63.448°
Mean Camber Angle-Trailing Edge	22.534°
Stagger Angle	52.316°
Camber Angle	40.913°
Solidity	1.9

TABLE III
STREAM-TUBE CONVERGENCE

Axial Distance in.	Sidewall Spacing in.
0	2.868*
.368	2.580
.736	2.236
1.104	1.911
1.472	1.656
1.840	1.485**
2.116	1.397

* This would have been the sidewall spacing at the blade leading edge; however, the sidewalls were shortened 0.030 in. to permit visibility of the blade tips in the schlieren image.

** This is sidewall spacing at blade trailing edge.

TABLE IV
SPLITTER VANE CONTOUR POINTS

<u>Station</u>	<u>XS</u>	<u>YS</u>	<u>XP</u>	<u>YP</u>
1	+.92075	+1.61292	+.92826	+1.60738
2	.93010	1.62755	.93954	1.62045
3	.95100	1.65932	.96446	1.64896
4	.97206	1.69039	.98921	1.67696
5	.99333	1.72076	1.01375	1.70439
6	1.01476	1.75044	1.03812	1.73131
7	1.03638	1.77940	1.06234	1.75765
8	1.05816	1.80765	1.08636	1.78348
9	1.08009	1.83521	1.11024	1.80874
10	1.10218	1.86207	1.13397	1.83346
11	1.12441	1.88821	1.15756	1.85766
12	1.14678	1.91366	1.18100	1.88130
13	1.16928	1.93838	1.20430	1.90440
14	1.19192	1.96241	1.22749	1.92698
15	1.21466	1.98575	1.25055	1.94902
16	1.23753	2.00838	1.27351	1.97052
17	1.26049	2.03033	1.29636	1.99151
18	1.28354	2.05160	1.31912	2.01197
19	1.30670	2.07217	1.34179	2.03193
20	1.32994	2.09207	1.36436	2.05138
21	1.35325	2.11130	1.38686	2.07034
22	1.37663	2.12986	1.40930	2.08880
23	1.40007	2.14776	1.43166	2.10677
24	1.42358	2.16502	1.45397	2.12428
25	1.44713	2.18161	1.47625	2.14132
26	1.47071	2.19760	1.49845	2.15791
27	1.49435	2.21296	1.52064	2.17405
28	1.51801	2.22769	1.54279	2.18976
29	1.54171	2.24184	1.56492	2.20505
30	1.56540	2.25540	1.58704	2.21993
31	1.58913	2.26837	1.60913	2.23441
32	1.61285	2.28079	1.63121	2.24850
33	1.63660	2.29265	1.65328	2.26221
34	1.66033	2.30399	1.67538	2.27556
35	1.68406	2.31480	1.69746	2.28859
36	1.70778	2.32512	1.71955	2.30126
37	1.73149	2.33497	1.74164	2.31363
38	1.75520	2.34433	1.76376	2.32568
39	1.77888	2.35323	1.78589	2.33745
40	1.80256	2.36173	1.80802	2.34895
41	1.82618	2.36981	1.83023	2.36021
42	1.83322	2.37220	1.83687	2.36359

TABLE V

SPLITTER VANE PHYSICAL CHARACTERISTICS

Chord	1.185 in.
Axial Chord	.916 in.
Blade Span-Inlet Plane	2.060 in.
Blade Span-Exit Plane	1.477 in.
Max. Thickness/Chord Ratio	.045
Mean Camber Angle-Leading Edge	53.512°
Mean Camber Angle-Trailing Edge	22.924°
Stagger Angle	39.754°
Camber Angle	30.588°

splitter vane. Finally, the mean camber line of each splitter vane was located midway between the mean camber lines of any two adjacent blades. Table V shows the splitter vane physical characteristics.

The objective of this program was to determine experimentally the effect of splitter vane circumferential location on the cascade flow characteristics. In addition to testing the cascade with the splitter vanes at the design setting, the cascade was investigated with the splitter vane at various circumferential locations on either side of the design. This was accomplished by mounting the splitter vanes on a sliding bar, as is shown in Figure 6. It should be noted that the original cascade sidewall contour was maintained on this sliding bar. The principal blades were locally slotted to allow for splitter movement when assembled. Circumferential movement of the splitter bar was possible without a complete teardown of the cascade. This was accomplished by means of a locknut as shown in Figure 7, which was located in the probe survey slot. With the desired circumferential location attained, the locknut was retightened and the testing resumed. Although not utilized in this experiment, the splitter vane rotatable reset feature of the original program^(2,3) was kept intact in the present program.

Figure 8 shows a three-quarter view of the earlier configuration cascade assembly, with windows, bleed ducting, and manifolds

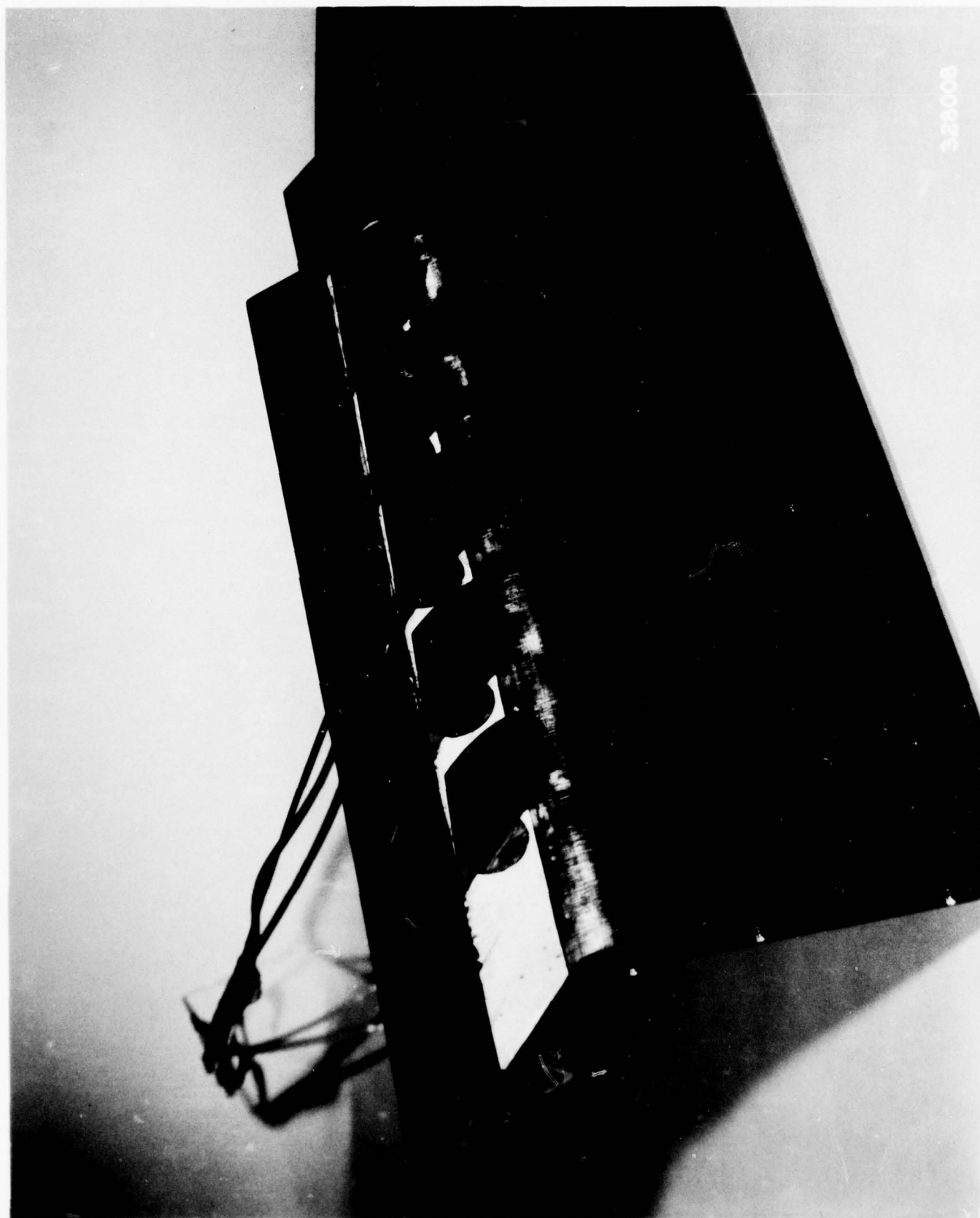
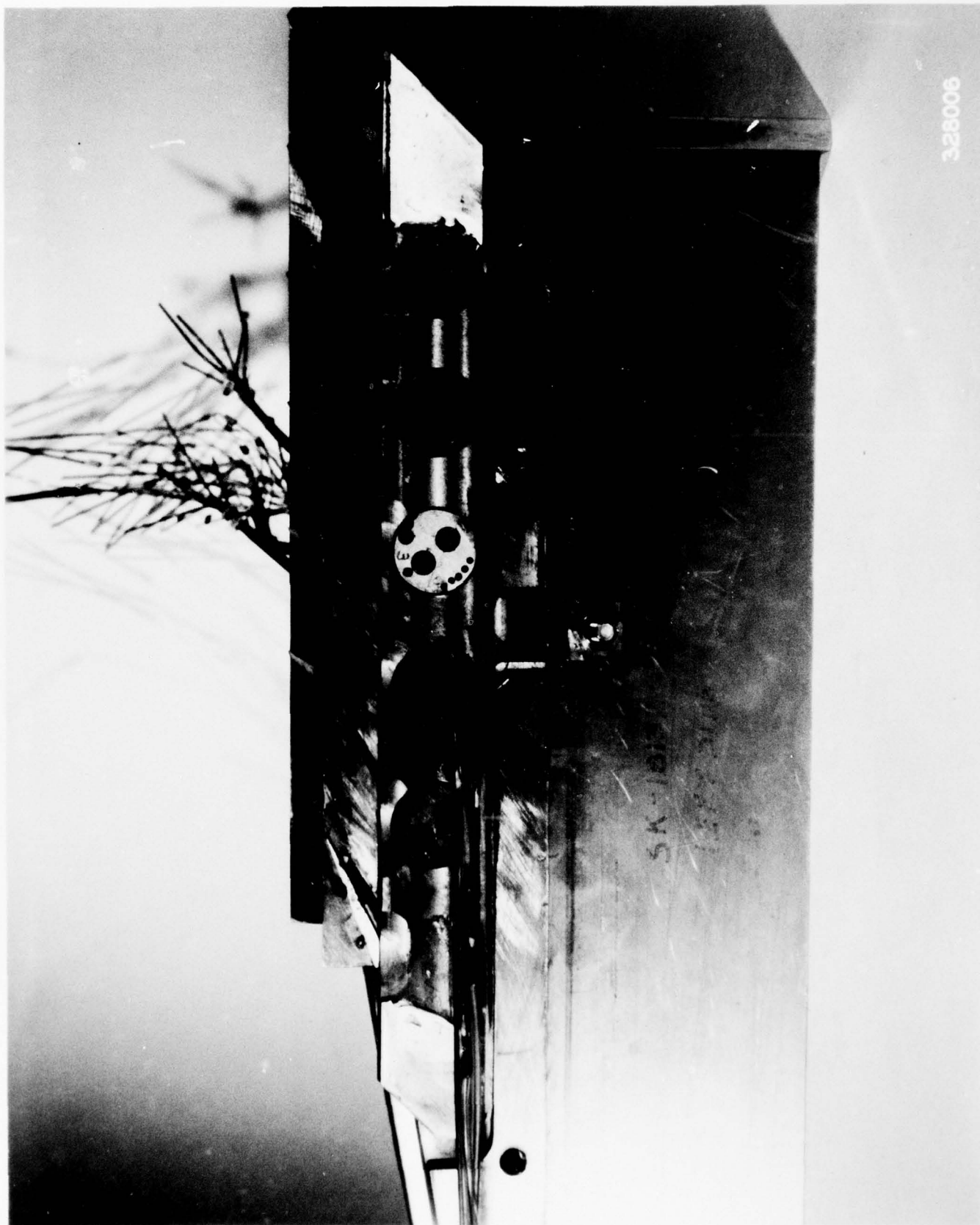


FIGURE 6. ONE SIDEWALL WITH SPLITTER VANE SLIDER BAR IN PLACE



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FIGURE 7. ONE SIDEWALL AND SPLITTER VANE SLIDER BAR
ILLUSTRATING LOCKING NUT

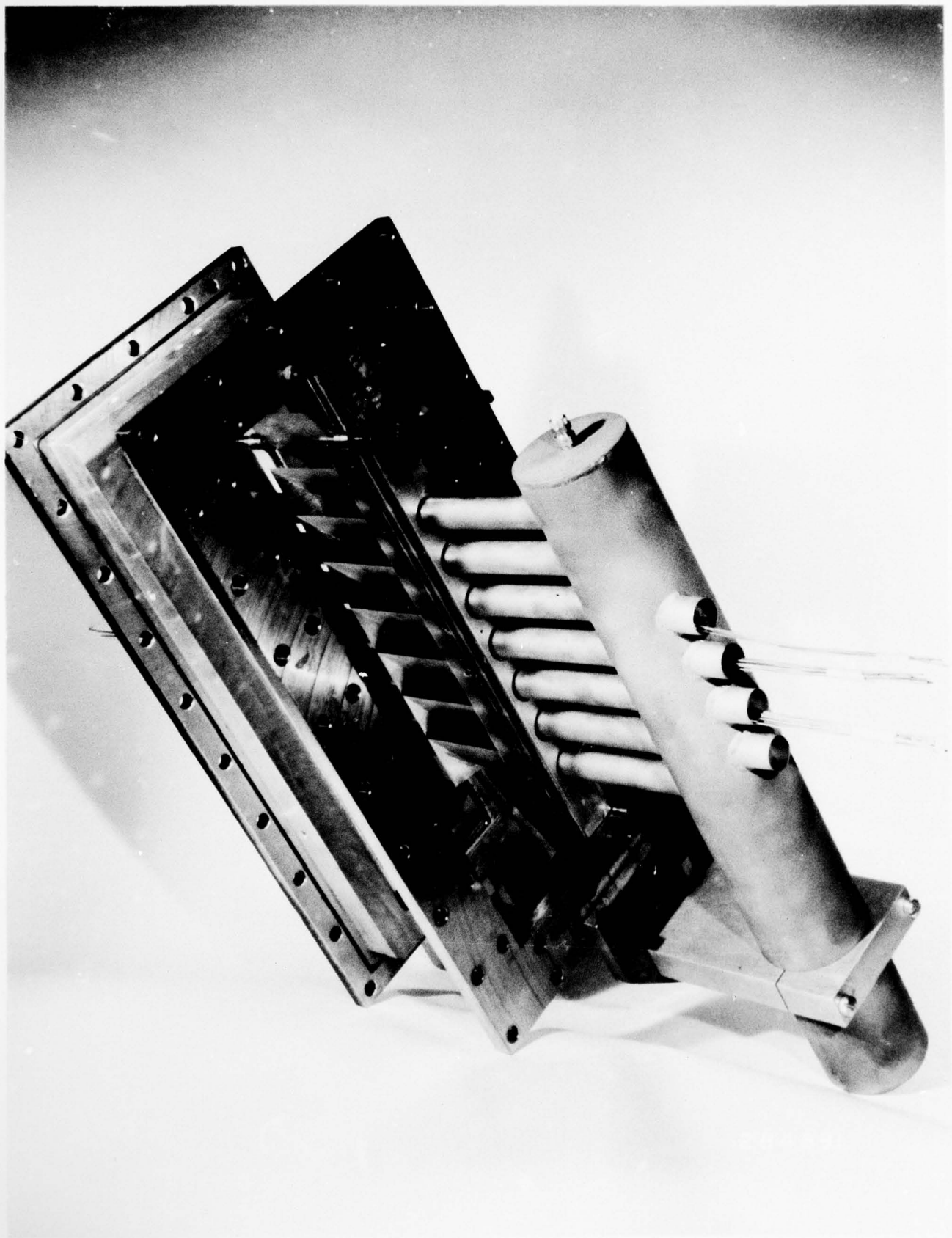


FIGURE 8. THREE-QUARTER VIEW OF CASCADE ASSEMBLY

visible. The method of running static tap tubes out of the ducts and manifolds is also illustrated.

Figure 9 presents a close-up of the tunnel with the cascade in place. A probe traversing mechanism is mounted on the rotor over the window. One of the bleed ducts attached to one of the manifolds as well as some of the schlieren apparatus are shown.

A total of 41 test conditions were investigated with the described cascade. Variables considered included static pressure ratio and circumferential splitter vane location at a constant inlet Mach number of 1.46.

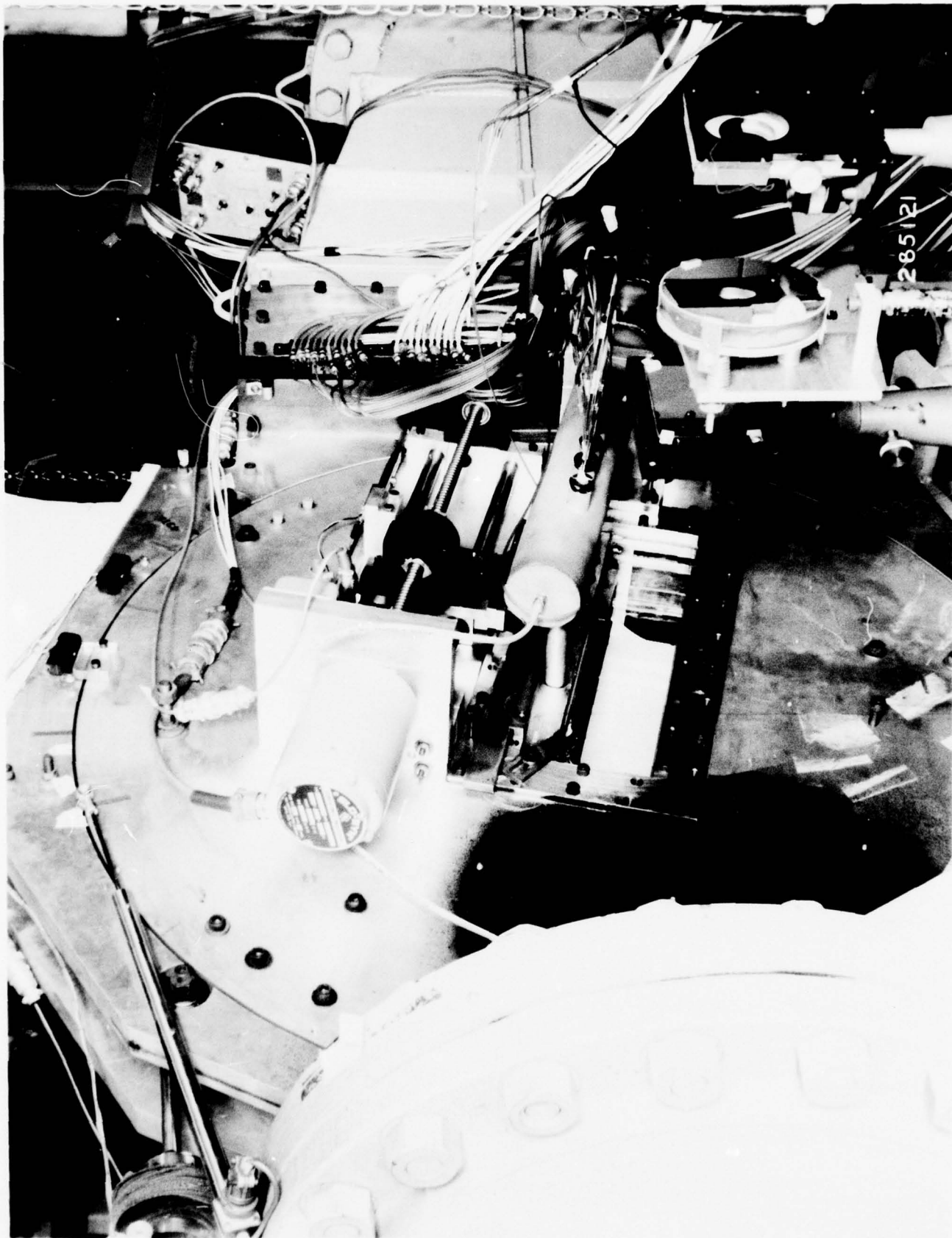


FIGURE 9. CLOSE-UP OF CASCADE ASSEMBLY IN WIND TUNNEL

SECTION III

INSTRUMENTATION

The wind tunnel used in this program is equipped with a sophisticated instrumentation system for the investigation of airfoil aerodynamic and/or aeroelastic characteristics. The instrumentation system is designed around a laboratory-size digital computer to provide rapid on-line data acquisition and reduction. This computer has a 32,000 word core memory with a 16-bit word length. Memory cycle time is 0.90 μ sec. Peripheral equipment includes a CRT display terminal, 80 column line printer (350 to 1100 lines per minute), high-speed paper tape punch, high speed paper tape reader, an X-Y digital plotter, 16 channel 100,000 Hz analog to digital converter and multiplexer system, and a magnetic disc storage unit with 2.5×10^6 word capacity. (See Figure 10.)

The use of the computer makes it possible to acquire raw data, convert it to engineering units and make computations while the experiment is in progress. This enables personnel to evaluate the experimental data during the test and results in maximum collection of scientific and engineering information for any program investment. Decisions to repeat some phases of the test can be made instantly. Also, optimum running conditions can be determined as well as the need for

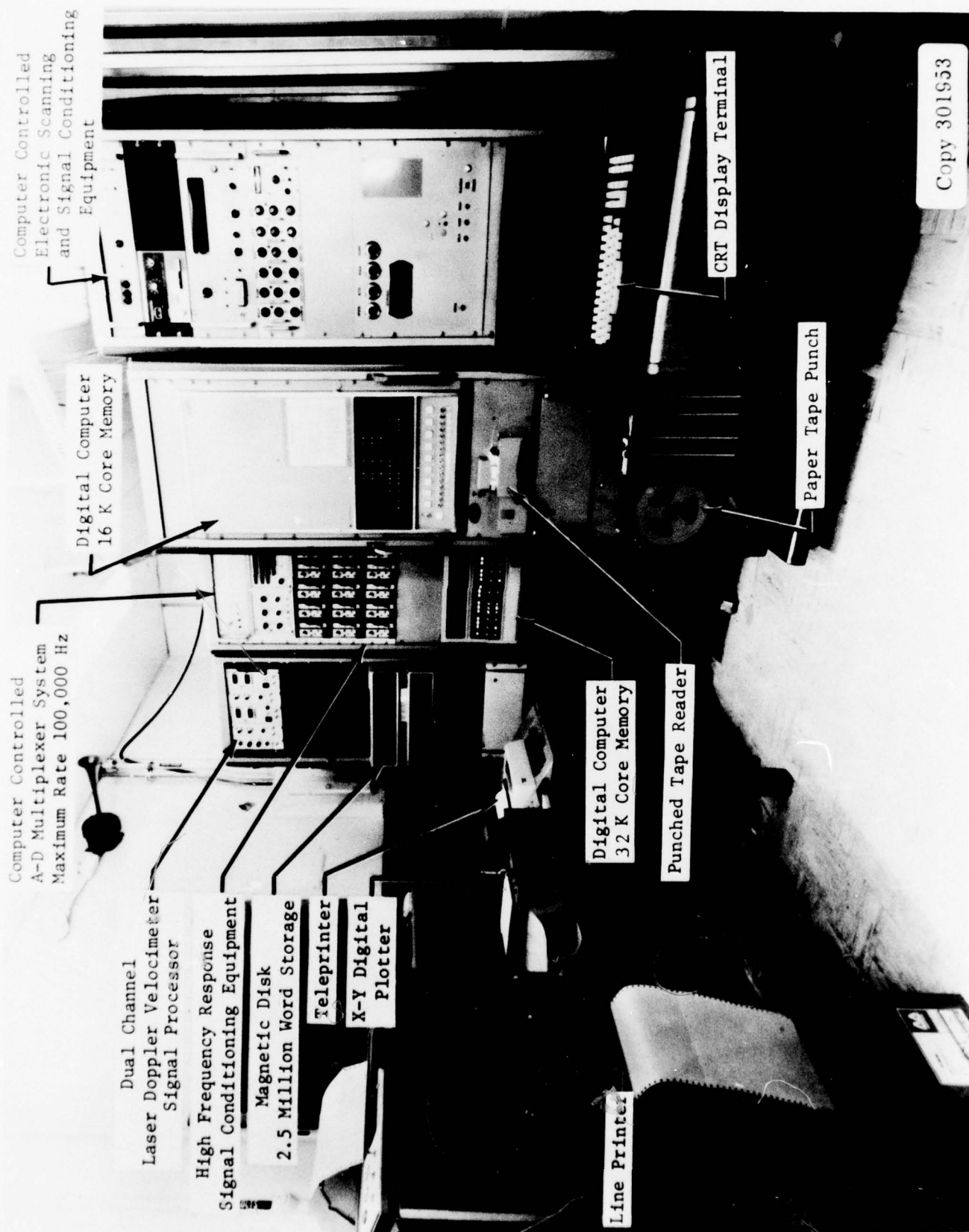


FIGURE 10. WIND TUNNEL ON-LINE DATA ACQUISITION SYSTEM

additional data to make the test more meaningful and nearly complete.

The operating environment of the computer and instrumentation system is a function of the experimental requirements. For aeroelastic (dynamic) airfoil cascade investigations, the wind tunnel capabilities include on-line control of instrumentation, cascade excitation to produce unsteady operation, dynamic data acquisition, and analysis of time variant cascade performance. The system digitizes analog signals at rates up to 100,000 Hz and has an input capacity up to 16 channels. Electronic switching of input signals to the multiplexer will allow 32 channels of analog signals to be analyzed. High frequency signal conditioning equipment for strain gages and high response miniaturized pressure transducers are available.

The objective of this program was to investigate the steady aerodynamic performance of an airfoil cascade. For this type of aerodynamic experiment, the computer is used for control of instrumentation, data acquisition, and data reduction. In the control mode, the computer operates a digital voltmeter, an electronic scanner, Scanivalve stepping motors, indexer for positioning the conical probe, and the computer peripheral equipment.

During wind tunnel operation, the computer is capable of acquiring automatically any data required to determine the performance characteristics of the cascade being tested. Pressure measurements are obtained by utilizing a Scanivalve system incorporating four 48 port rotary valves (Scanivalves), providing a total pressure measurement capacity of 192 pressures. Differential pressure measurements are obtained from individual pressure transducers as required. In addition, up to 48 temperature measurements are possible. Other necessary wind tunnel data which are determined by the computer include test section angular position (used to define the cascade inlet Mach number and flow direction) and conical probe position (angular, horizontal, and vertical).

During data acquisition, the computer performs two additional functions which can be easily accomplished by an on-line acquisition system. The first seven ports on each of the four Scanivalves are used for three reference calibration pressures. Each time the computer initiates a set of pressure readings the calibration pressures are measured, providing direct on-line calibration of the Scanivalve pressure transducers. Secondly, the wind tunnel total pressure and total temperature are monitored during data acquisition of each test point. If the pressure or temperature varies outside a preset tolerance, the computer automatically presents

the out-of-limit reading(s) and waits for instructions. The immediate data can be rejected and remeasured, the data for the complete test point rejected and a new set of data initiated or the out-of-limits condition can be overridden and acquisition of data continued.

The computer also reduces the cascade test data on-line. As the data are acquired, the computer analyzes the data to determine not only the test operating conditions but the complete performance characteristics of the cascade.

The desired test condition is established manually. The on-line instrumentation system then automatically completes the test condition data acquisition and reduction. This includes defining the cascade inlet flow field, positioning a conical probe at discrete points in the cascade passage to determine blade-to-blade flow field properties at the cascade exit, mass averaging and mixing to uniform flow conditions the blade-to-blade data to determine exit flow properties and overall performance, calculating instrumented blade, instrumented splitter vane, and sidewall passage performance, and plotting of instrumented blade and splitter vane parameters and blade-to-blade distribution of selected exit flow field properties. For each test condition, a total of approximately 450

measurements are made to define the cascade performance. The measurements, calculations, and print-out (11 pages) require 11 minutes and the plotting requires 6 minutes.

The specific instrumentation used with this cascade is summarized as follows.

- Inlet total pressure probe.
- Inlet total temperature thermocouple.
- 20 blade surface static pressure taps in cascade passage number 4, 10 on each of two blades. The location of each tap is included in each data set on the page of instrumented blade parameters. It should be noted that the first static tap on the blade suction surface was defective. Hence, the pressure measured by the second static tap on this surface was recorded for both taps throughout this experiment.
- Two static pressure taps on the pressure surface and 3 static pressure taps on the suction surface of splitter vane number 4. The location of each tap is included in each data set on the page of splitter vane parameters.
- Pressure taps in the trailing edge at mid-span of cascade blades 4 and 5.

- Nine static pressure taps on one of the sidewalls approximately $1/4$ chord downstream. One tap was at each midpassage and four others centered around blade number 4.
- A cone probe located 0.49 in. axially downstream from the cascade.
- Probe position transducer.
- Test section rotor angle transducer.
- Schlieren optical system.

SECTION IV

DATA REDUCTION PROCEDURES

The DDA Research Department supersonic wind tunnel on-line instrumentation system automatically acquires data from the wind tunnel, converts the data to engineering units, and makes computations while the experiment is in progress. Cascade experimental data and performance parameters can be evaluated during the test with the cascade operating characteristics available when the test is completed.

The wind tunnel on-line data reduction procedures to determine cascade aerodynamic performance parameters are described in detail in Appendix A. In general, the data reduction program calculates the following cascade performance parameters:

- Cascade inlet flow field properties such as inlet relative Mach number, axial and tangential Mach number, mass flow rate, incidence angle, flow direction, static and total pressure, total temperature, and Reynolds number.
- Cascade exit flow field properties at discrete points across the passage such as conical probe location, Mach number, axial and tangential Mach number, static and total pressure, total pressure recovery, flow direction, deviation angle, and turning.

- Mass-averaging of discrete data (Mach number, total pressure recovery, and flow direction) and calculation of additional exit performance data such as total and static pressure, axial and tangential Mach number, total to static temperature ratio, and exit to inlet mass flow ratio.
- Cascade overall performance based on mass-averaged data such as static pressure ratio, total pressure recovery, velocity, density and static temperature ratio, total pressure loss coefficient, total pressure loss parameter, diffusion factor, equivalent diffusion factor, flow Reynolds number, static pressure rise parameter, deviation angle, turning and area ratio.
- Cascade exit and overall performance based on a mixing loss analysis of the discrete data.
- Instrumented blade data and parameters such as local surface static pressure parameters, pressure ratios, net force and moment on the blades, and center of pressure.
- Instrumented splitter vane data and parameters such as local surface static pressure parameters and pressure ratios.

The on-line data reduction program also includes computer controlled plotting of cascade performance parameters.

The instrumented blade and splitter vane local surface static pressure rise parameter is plotted along with the blade-to-blade cascade exit performance data.

A detailed listing of data reduction equations is presented in Appendix A.

SECTION V

DISCUSSION OF EXPERIMENTAL RESULTS

An experimental investigation of the flow characteristics of this cascade was conducted after the cascade was modified to allow for quasi-circumferential movement of the splitter vanes. The effects of the addition of the splitter vanes to the cascade, as well as the splitter vane setting angle were previously evaluated⁽²⁾. The intent of this experiment was to determine the optimum circumferential location for the splitter vane at the design setting angle (39.76°) and the design inlet Mach number (1.46).

A synopsis of the experimental program is shown in Table VI. The cascade performance was investigated at eight splitter vane circumferential locations at the design inlet Mach number of 1.45. A total of 3 to 6 sets of data were obtained over a range of static pressure ratios at each splitter vane setting. Summaries of the common mass averaged performance parameters are presented in Table VII through XIV. Detailed data listings and performance parameters are included in the appropriate appendix, as referenced with each data set.

TABLE VI
SYNOPSIS OF TEST PROGRAM
INLET RELATIVE MACH NO. = 1.46

<u>SPLITTER VANE CIRCUMFERENTIAL LOCATION</u>	<u>STATIC PRESSURE RATIO RANGE</u>	<u>NUMBER OF DATA SETS</u>
50% (Nominal)	1.592 - 2.011	7
52%	1.683 - 1.995	6
55%	1.642 - 1.895	5
60%	1.625 - 1.965	3
48%	1.719 - 2.013	5
45%	1.706 - 1.987	5
43%	1.707 - 1.986	6
38%	1.593 - 2.057	4

TABLE VII

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 50%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.592	1.019	.158	.390	28.02	5.49
1.635	.994	.162	.407	28.33	5.80
1.686	.958	.171	.432	27.95	5.42
1.752	.924	.175	.458	28.07	5.54
1.880	.845	.189	.516	27.68	5.15
1.949	.805	.194	.547	27.49	4.96
2.011	.769	.200	.576	27.18	4.65

NOTE: See Appendix C for data.

TABLE VIII

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 52%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.683	.973	.154	.422	27.91	5.37
1.750	.932	.163	.452	27.90	5.36
1.818	.894	.169	.480	27.91	5.38
1.894	.851	.174	.512	27.79	5.25
1.941	.821	.182	.535	27.71	5.18
1.995	.783	.194	.564	27.58	5.04

NOTE: See Appendix D for data.

TABLE IX

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 55%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.643	.977	.178	.419	28.09	5.56
1.734	.919	.193	.461	27.96	5.42
1.794	.888	.193	.484	27.86	5.32
1.848	.851	.203	.511	27.91	5.38
1.895	.829	.200	.527	28.21	5.67

NOTE: See Appendix E for data.

TABLE X

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 60%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.625	.943	.237	.446	27.16	4.63
1.805	.849	.232	.514	27.55	5.02
1.965	.770	.226	.573	28.12	5.58

NOTE: See Appendix F for data.

TABLE XI

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 48%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.718	.952	.157	.439	27.29	4.76
1.786	.911	.166	.469	27.19	4.65
1.836	.881	.172	.491	27.14	4.60
1.964	.800	.192	.553	26.87	4.33
2.013	.773	.194	.573	26.89	4.36

NOTE: See Appendix G for data.

TABLE XII

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 45%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.706	.963	.151	.431	27.30	4.77
1.786	.915	.162	.466	27.35	4.82
1.822	.900	.158	.477	27.44	4.91
1.918	.842	.169	.520	27.30	4.76
1.987	.797	.183	.554	27.30	4.77

NOTE: See Appendix H for data.

TABLE XIII

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 43%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.707	.950	.164	.438	27.68	5.15
1.790	.905	.168	.472	27.58	5.04
1.856	.867	.174	.500	27.49	4.96
1.917	.829	.182	.529	27.28	4.75
1.956	.800	.193	.551	27.28	4.75
1.986	.779	.200	.567	27.13	4.6

NOTE: See Appendix I for data.

TABLE XIV

SUMMARY OF MASS AVERAGED CASCADE PERFORMANCE PARAMETERS
SPLITTER VANE CIRCUMFERENTIAL LOCATION = 38%

$P)_2/P)_1$	$MN)_2$	OMEGA	DF	$BETA)_2$	DEV
1.593	1.003	.179	.406	26.46	3.93
1.844	.846	.210	.518	26.73	4.20
1.984	.756	.230	.585	27.39	4.85
2.057	.704	.244	.625	28.01	5.47

NOTE: See Appendix J for data.

The experiment was initiated with the splitter vane located at the design (nominal-50%) tangential location. The resulting data is shown in Figure 11 together with the data obtained and reported previously⁽²⁾ at the same splitter vane equivalent location. The agreement in the mass average exit Mach number and exit air angle data is excellent. The mass average loss level associated with the present cascade data is very slightly decreased as compared to the original test data. This is due in part to the tighter splitter vane-endwall clearances maintained during the present experiment. These tighter clearances were attained because the splitter vane rotatable reset feature was not utilized in the current investigation.

Upon completion of the nominal testing, the splitter vanes were displaced tangentially. Tangential movement is expressed in terms of percent displacement from the adjacent blade pressure surface. The nominal design tangential location is at 50%.

Figure 12 shows some of the resulting cascade performance parameters as functions of the mass average static pressure ratio for splitter vane resets above 50%, i.e. movement of the splitter vanes nearer to the suction surface of the adjacent blade. For these cases, the changes in the cascade

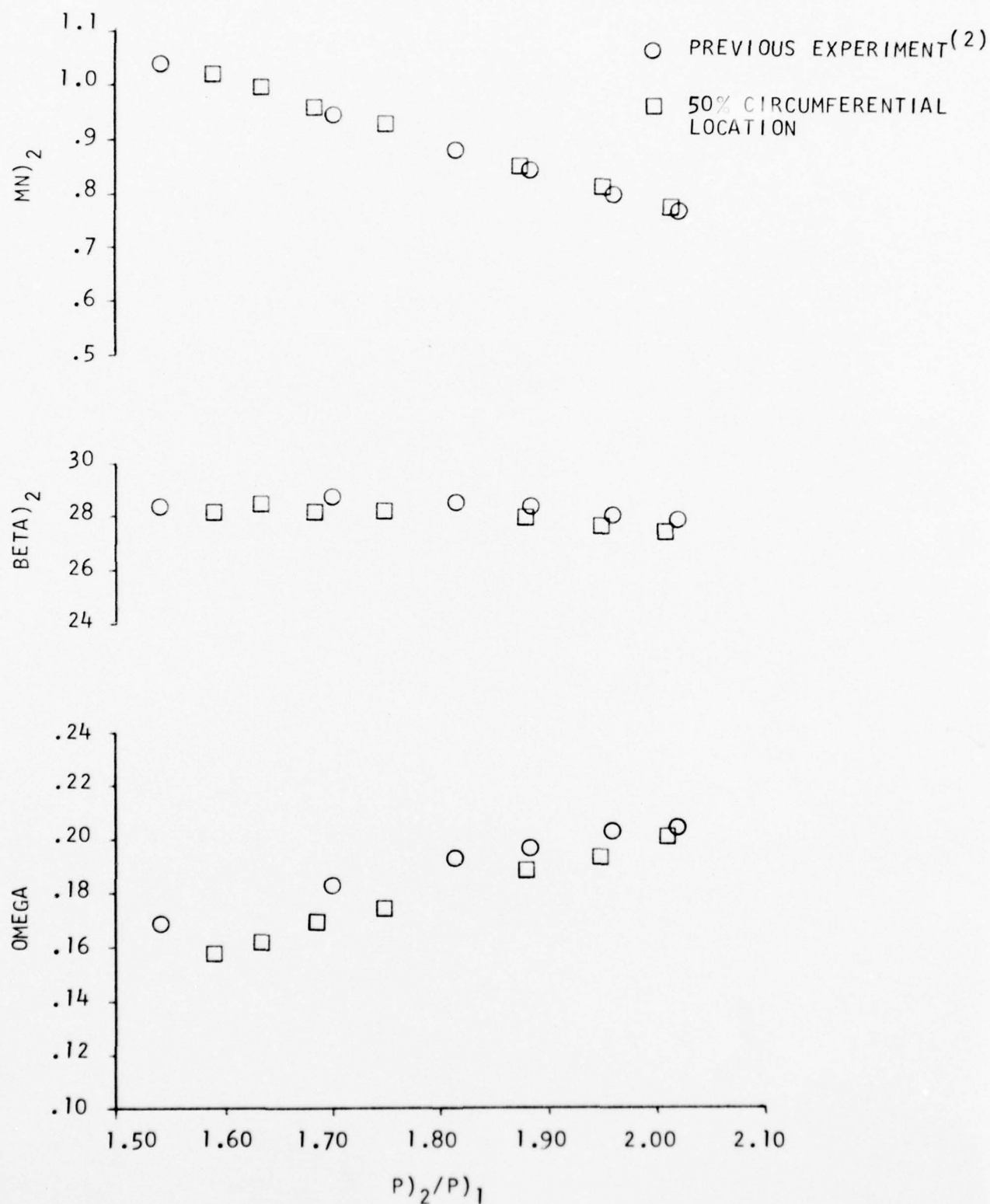


FIGURE 11. CASCADE PERFORMANCE PARAMETERS-COMPARISON OF 50% CIRCUMFERENTIAL LOCATION TO PREVIOUS EXPERIMENTAL RESULTS

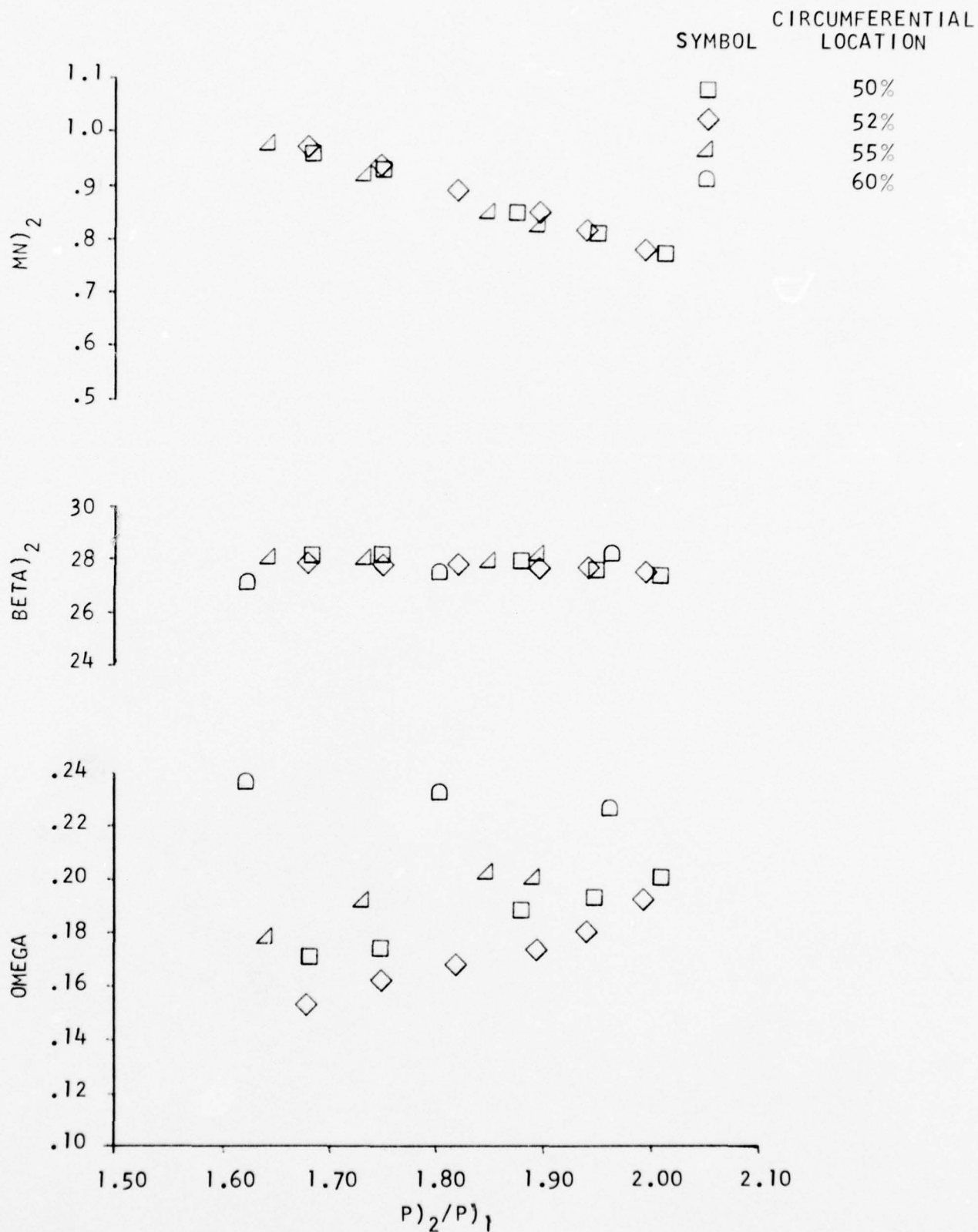


FIGURE 12. CASCADE PERFORMANCE PARAMETERS-CIRCUMFERENTIAL LOCATIONS OF 50% AND GREATER

mass averaged exit Mach number and air angle as compared to the nominal 50% data are small. The greatest decrease in the mass average loss level, approximately 5%, was realized at the 52% reset of the splitter vanes. Further tangential resets of 55% and 60% resulted in increased loss levels over the nominal location.

The performance results for splitter vane resets less than 50%, i.e., movement of the splitter vanes nearer to the pressure surface of the adjacent blade, are shown in Figure 13. Again, changes in mass average cascade exit Mach number are small as compared to the nominal data. Some slight improvement in cascade turning exists for these resets, as illustrated by the lower level of the mass average exit air angle. Improvements in cascade loss level are realized for tangential resets of 48, 45 and 43%, with the largest gain being associated with the 45% reset.

To establish the minimal loss tangential reset location of the splitter vanes, the loss level data at the cascade design mass average static pressure ratio of 1.85 was investigated as a function of the tangential reset location. This data, presented in Figure 14, reveals that lower loss levels can be realized on either side of the nominal tangential splitter location, with the minimum loss position associated with the 45% tangential location of the splitter vanes.

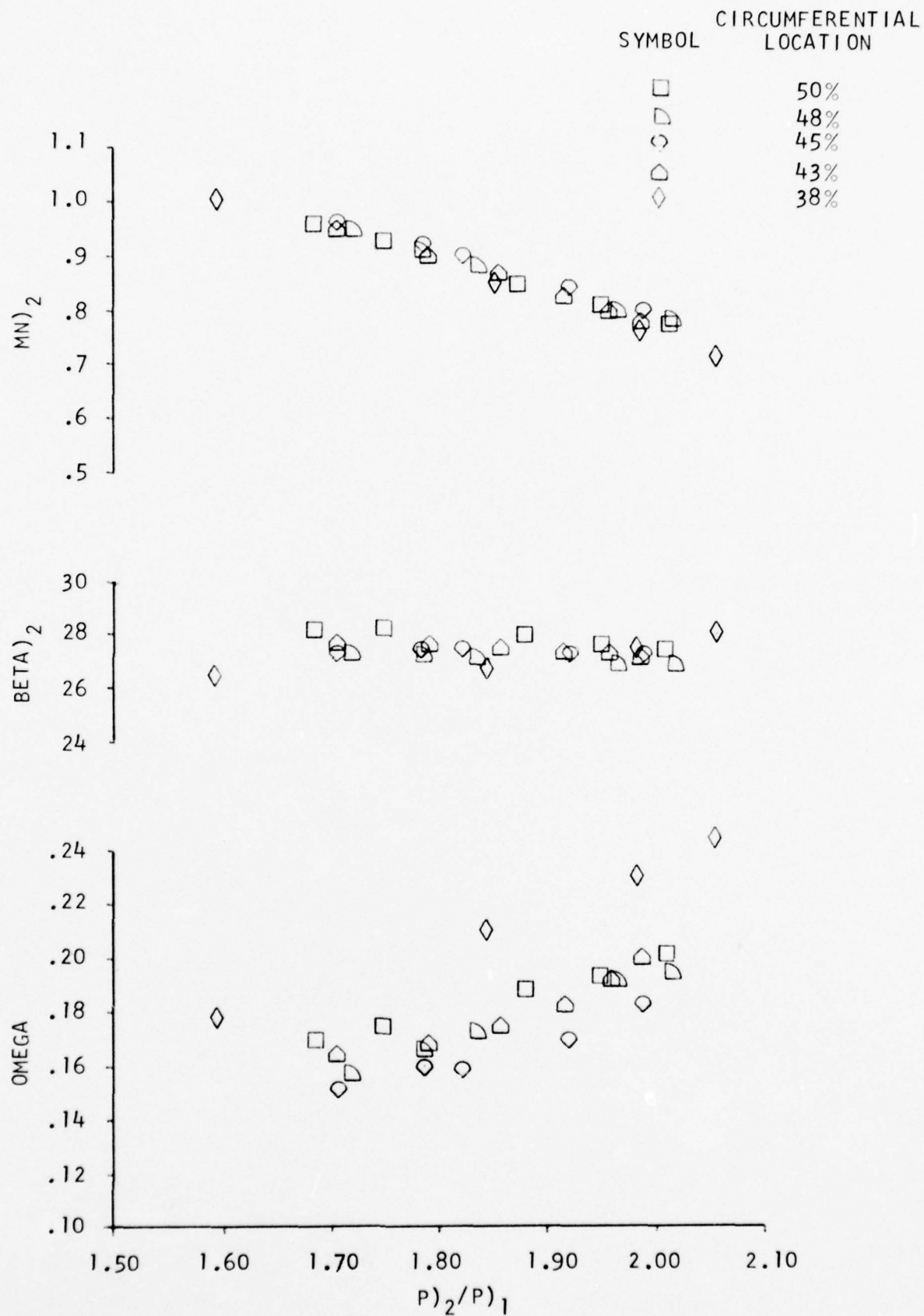
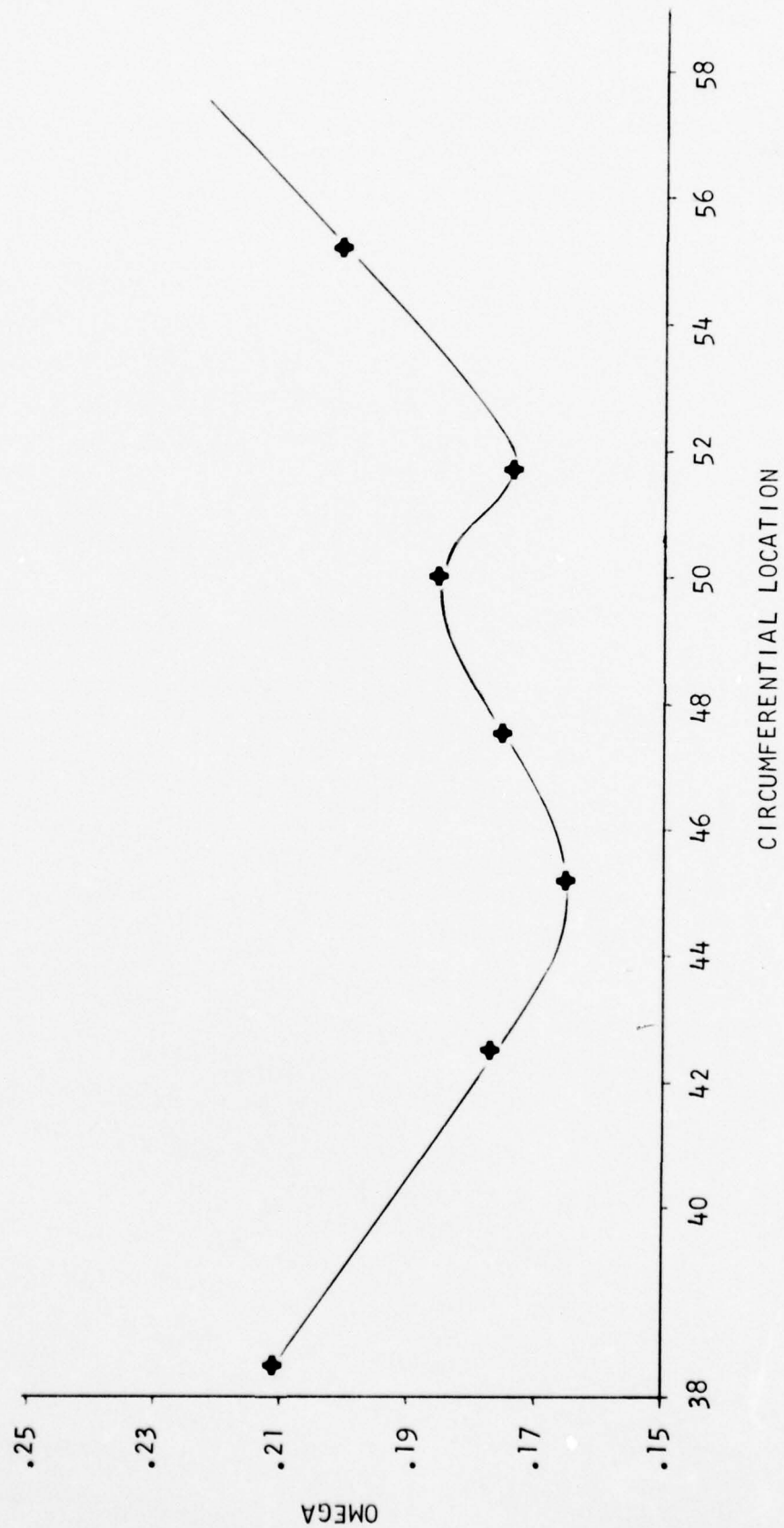


FIGURE 13. CASCADE PERFORMANCE PARAMETERS -
CIRCUMFERENTIAL LOCATIONS OF 50% AND LESS

FIGURE 14. EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON CASCADE LOSS LEVEL AT CONSTANT 1.85 PRESSURE RATIO



To more completely understand these results, a detailed examination of the resulting wake surveys was conducted. Figure 15 presents the results of the wake surveys for the splitter resets greater than 50% at a level of static pressure ratio near design. In this figure, the total pressure recovery is plotted versus the percentage of the passage surveyed, representative of the downstream wake behind blade 4 and splitter 4. The mass averaged values of static pressure ratio and total pressure loss for the wakes are also noted along with an interpolated value for total pressure loss at a 1.85 pressure ratio. For purposes of discussion, the wake survey is considered as three regions, illustrated in Figure 15. These are the 1) blade wake, 2) splitter vane wake and 3) core flow loss wake. As can be seen, only trivial differences exist between the wakes for the nominal and the 52% tangential location of the splitter vanes.

The major area of difference is associated with the splitter vane wake loss level. Further positive increases in the tangential reset position of the splitters results in increases in total pressure recovery in all three regions. The increased splitter vane wake losses associated with the positive resets may be related to the relative location of the splitter inlet flow field to the blade suction surface, resulting in an undesirable inlet incidence to the splitter vane.

SYMBOL	CIRCUMFERENTIAL LOCATION	P_2/P_1	OMEGA	OMEGA) _{1.85}
—	50%	1.880	.189	.186
- - -	52%	1.818	.169	.174
- - -	55%	1.848	.203	.201

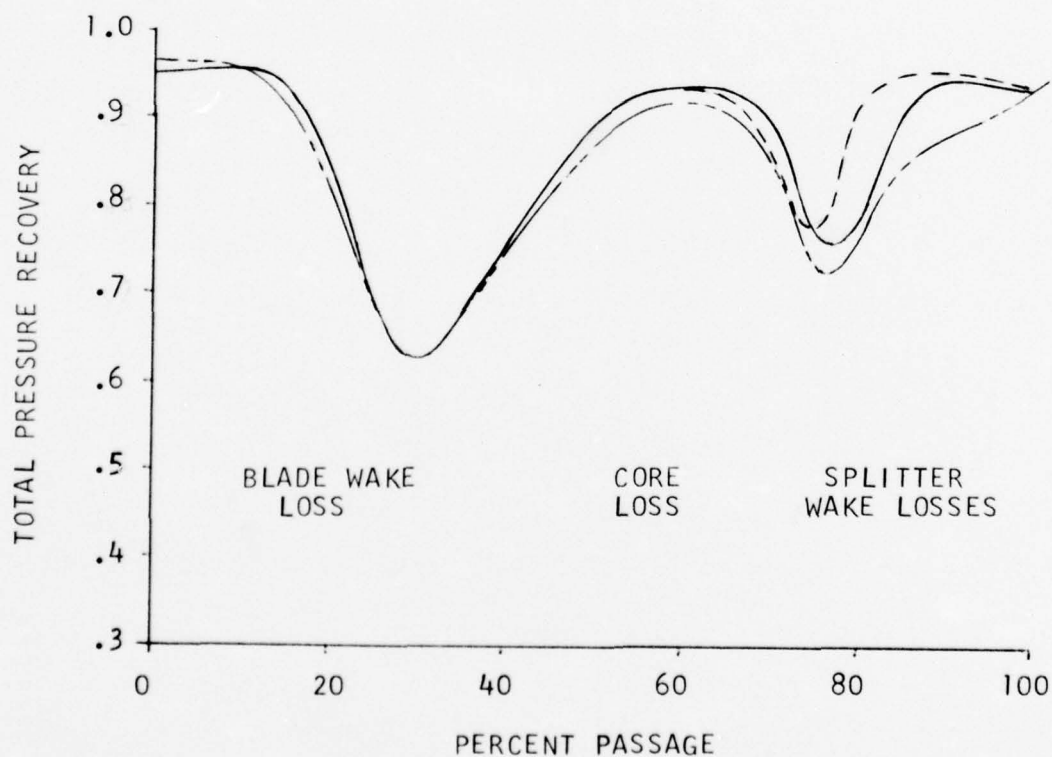


FIGURE 15. COMPARISON OF WAKE SURVEYS FOR CIRCUMFERENTIAL LOCATIONS OF 50% AND GREATER

Figure 16 is the wake survey study for splitter reset locations less than 50%. Again, the resulting cascade mass average pressure ratio and loss levels are included. These negative resets result in generally lower splitter vane wake losses with a similar trend existing for the core flow portion of the cascade. Slight improvements in blade loss level also appear, with the 45% reset yielding the best combination of these loss levels.

Figure 17 compares the two minimum loss tangential resets to the nominal wake survey. Again it can be observed that the 45% reset exhibits lower loss levels in all three regions of the survey, with the biggest gains appearing in the core and blade wake. It should also be noted that the pressure surface Mach number distribution of the 45% setting is also the most continuous at the conditions tested.

Finally, examination of the blade suction surface static pressure data at the design inlet Mach number indicates the presence of the inlet shock wave impinging onto the suction surface near the 50% chord station. This is also the region on the suction surface of the blade where curvature begins to increase rapidly. This combination of high surface curvature and shock wave impingement could result in a highly separated boundary layer caused by the interaction of the inlet shock wave with the suction surface boundary layer.

SYMBOL	CIRCUMFERENTIAL LOCATION	P_2/P_1	OMEGA	OMEGA) _{1.85}
—	50%	1.880	.189	.186
- - -	48%	1.836	.172	.175
· · ·	45%	1.822	.158	.165

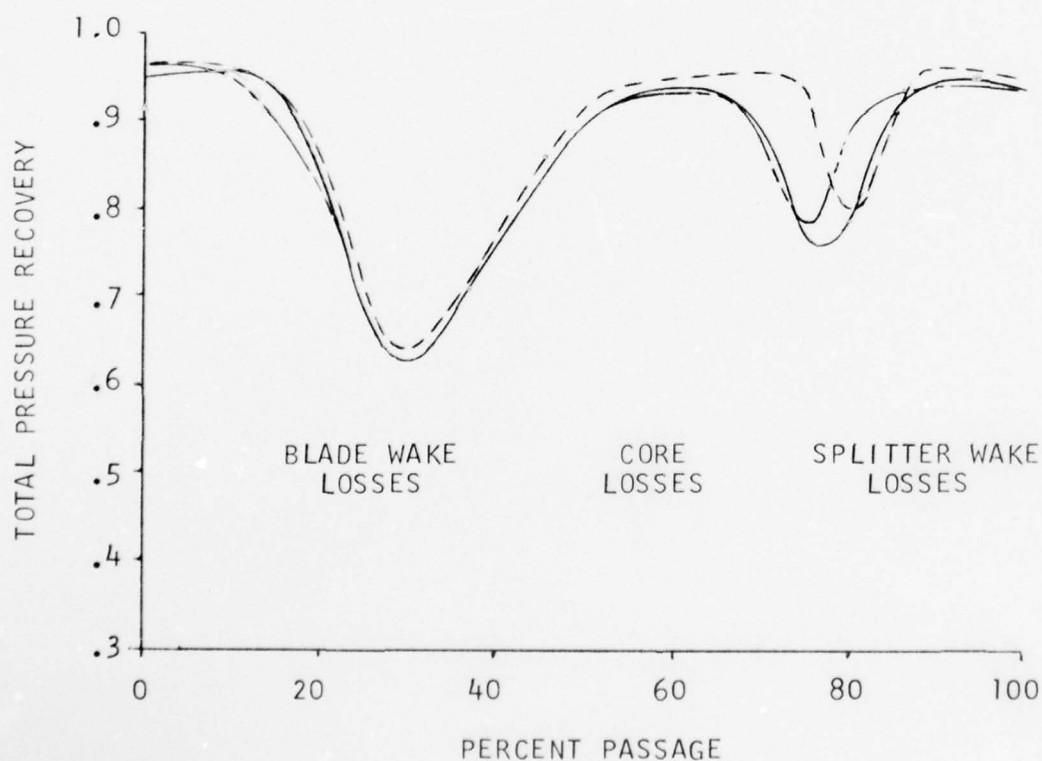


FIGURE 16. COMPARISON OF WAKE SURVEYS FOR CIRCUMFERENTIAL LOCATIONS OF 50% AND LESS

SYMBOL	CIRCUMFERENTIAL LOCATION	P_2/P_1	OMEGA	OMEGA) _{1.85}
————	50%	1.880	.189	.186
- - - - -	45%	1.822	.172	.175
- - - - -	52%	1.818	.169	.174

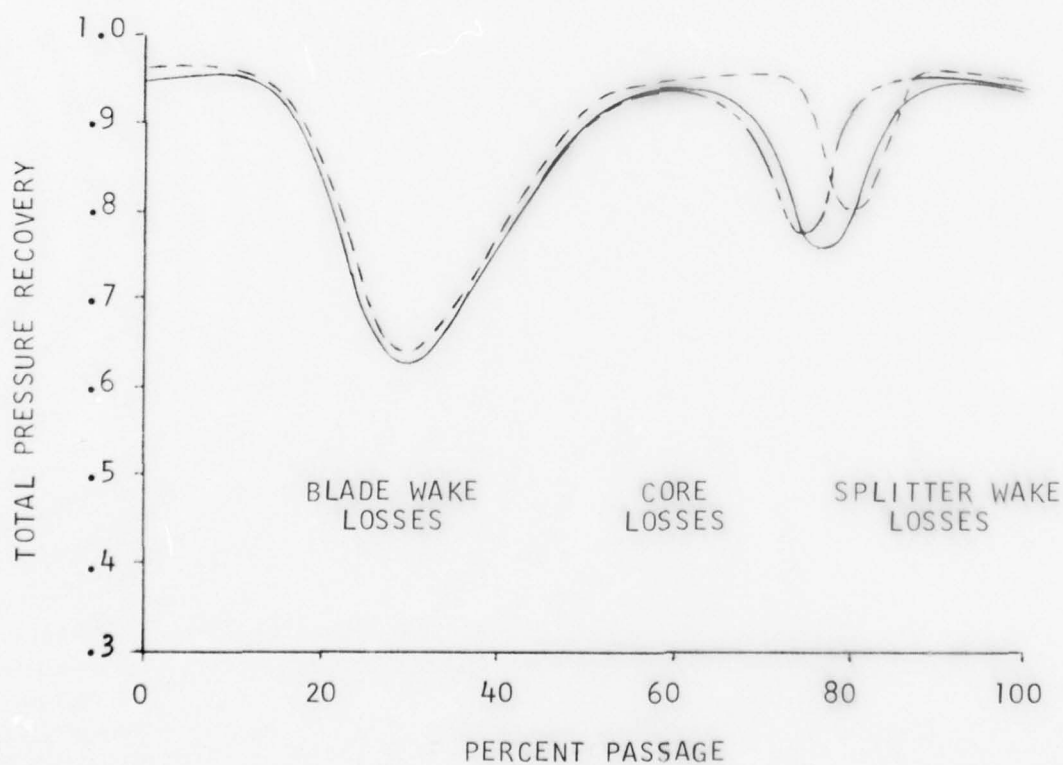


FIGURE 17. COMPARISON OF WAKE SURVEYS FOR MINIMUM LOSS CIRCUMFERENTIAL LOCATIONS

Once this condition is reached, the relative location downstream of the splitter vanes could make them ineffective in turning the airflow.

SECTION VI
SUMMARY AND CONCLUSIONS

A cascade of blades incorporating splitter vanes was investigated over a range of static pressure ratios at a 1.46 inlet Mach number to determine a preferred splitter vane circumferential location. The cascade modeled a selected blade element from an axial compressor rotor which incorporated splitter vanes. A total of 41 data points were evaluated over a static pressure ratio range between 1.6 and cascade spill for various circumferential splitter positions. After reviewing these data, the following conclusions were drawn.

- Tangential splitter resets greater than nominal have little effect on cascade mass averaged exit Mach number and air angle as compared to the nominal location.
- Small tangential splitter resets greater than nominal result in some improvement (5% at a 1.85 pressure ratio) in the mass averaged total pressure loss over the nominal location. These performance gains are associated with the wake loss of the splitter vane.
- Circumferential splitter resets less than 50% result in increased cascade turning as compared to the nominal tangential location, i.e. lower mass average air angle.

- Circumferential splitter resets between 43% and 48% result in improved mass average loss level over the nominal location, with the 45% location yielding a 10% decrease in loss level at a cascade pressure ratio of 1.85. Resets less than 50% in general were less detrimental to cascade loss level than those greater than 50%.
- Circumferential resets greater than 50% result in increased splitter wake losses. This could be related to increased incidence on the splitter vane resulting from flow separation from the blading suction surface.
- Because of the close proximity of the impinging shock wave and the region of increased curvature on the principal blade suction surface, the effect of shock boundary layer interaction on the degree of separation from the surface is increased. Forward axial movement of the splitter may improve this condition.

APPENDIX A
DATA REDUCTION EQUATIONS

This Appendix presents the data reduction procedures which are incorporated in the DDA wind tunnel on-line instrumentation system to analyze experimental data from supersonic compressor cascades. Figure 18 presents a sketch of the cascade flow field.

1. NOZZLE EXIT CONDITIONS

The DDA supersonic wind tunnel utilizes fixed converging-diverging nozzles to provide a supersonic flow field to the wind tunnel test section. The design Mach number of the fixed supersonic nozzles (M_{n0}) has been experimentally verified in nozzle calibration studies. The wind tunnel total pressure (P_{T0}) or nozzle exit total pressure is measured in a low velocity stagnation plenum with a total pressure probe. Likewise, the wind tunnel total temperature (T_{T0}) or nozzle exit total temperature is measured in a low velocity stagnation plenum with a total temperature probe.

2. CASCADE INLET CONDITIONS

The cascade inlet flow field is established by a sharp leading edge wedge which is positioned upstream of the first blade in the cascade. The cascade inlet flow direction is determined by the orientation of the wedge with respect to the airfoils. The cascade inlet Mach number is determined by the orientation of the wedge with respect to the nozzle exit flow field. The inlet Mach number is established by either expanding or compressing (shocking) the nozzle flow about the wedge. This is accomplished by rotating the test section with respect to the nozzle. The boundary layer thickness on the wedge has been established experimentally and is taken into account when positioning the wedge with respect to the airfoils.

The degrees of expansion or compression of the nozzle flow field (Δ) is determined by:

$$\Delta = \theta_W - (90^\circ - \theta_{TS})$$

The wedge angle (θ_W) is defined as the angle between axial direction and the wedge surface, including boundary layer thickness. The test section angle (θ_{TS}) is defined as the angle between tangential direction and the wind tunnel axis (horizontal). By definition, if delta (Δ) is positive, the nozzle exit flow field will undergo an oblique shock and the resulting cascade inlet flow field properties will be obtained from the governing oblique shock relations. If delta is negative, the nozzle flow field will undergo a Prandtl-Meyer expansion from which the inlet properties will be determined.

Employing the governing equations, which are discussed in Reference 6, for either expansion or compression, one can establish the cascade inlet Mach number (M_{n1}) based on delta. If the flow undergoes an oblique shock, the loss in total pressure across the shock is also calculated to determine the cascade inlet total

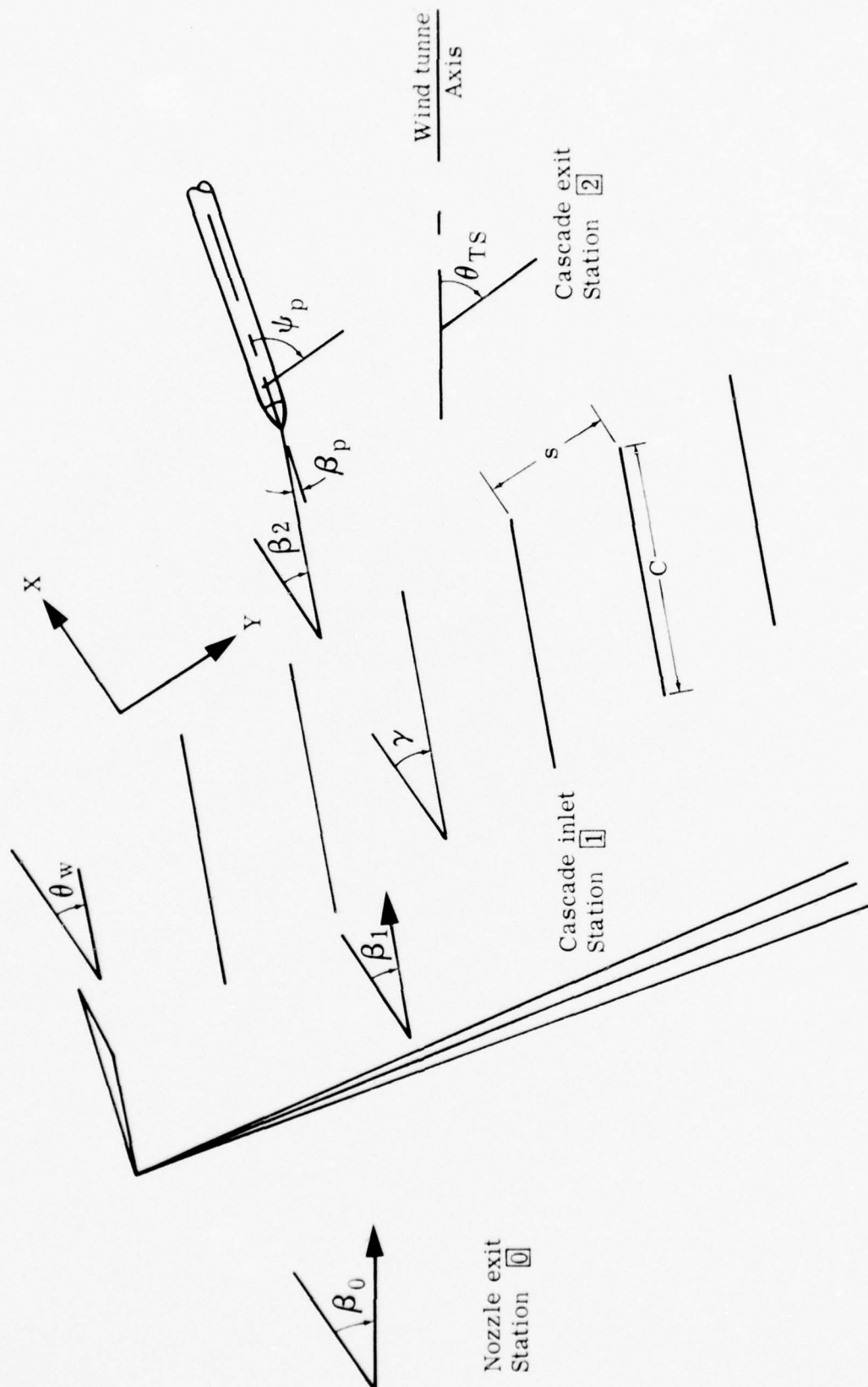


FIGURE 18. SCHEMATIC OF SUPERSONIC COMPRESSOR CASCADE FLOW FIELD

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pressure (P_{T1}). The cascade inlet flow direction (β_1) is set equal to the wedge angle. The inlet total temperature (T_{T1}) is assumed to be equal to the tunnel total temperature.

Additional cascade inlet flow field parameters are calculated as follows:

Inlet static pressure P_1

$$P_1 = \frac{P_{T1}}{\left[1 + \frac{k-1}{2} Mn_1^2\right]^{\frac{k}{k-1}}}$$

Inlet axial Mach number Mn_{X1}

$$Mn_{X1} = Mn_1 \cos \beta_1$$

Inlet tangential Mach number Mn_{Y1}

$$Mn_{Y1} = Mn_1 \sin \beta_1$$

Inlet total to static temperature ratio $\frac{T_{T1}}{T_1}$

$$\frac{T_{T1}}{T_1} = 1 + \frac{k-1}{2} Mn_1^2$$

Inlet total to static pressure ratio $\frac{P_{T1}}{P_1}$

$$\frac{P_{T1}}{P_1} = \left[1 + \frac{k-1}{2} Mn_1^2\right]^{\frac{k}{k-1}}$$

Inlet mass flow rate per passage per inch span m_1

$$m_1 = P_1 Mn_{X1} \sqrt{\frac{kg}{RT_{T1}}} \sqrt{\frac{T_{T1}}{T_1}} \quad s$$

for $k = 1.4$, $g = 32.175 \text{ ft/sec}^2$, $R = 53.34 \frac{\text{ft-lb}}{\text{lb-}^\circ\text{R}}$

$$m_1 = .91896 \frac{P_1 M n_{X1}}{\sqrt{T_{T1}}} \sqrt{\frac{T_1}{T_{T1}}} \quad s$$

Inlet dynamic pressure Q_1

$$Q_1 = \frac{1}{2} k P_1 M n_1^2$$

Inlet Reynolds number N_{R1}

$$N_{R1} = \frac{12 P_1 M n_1 \sqrt{\frac{kg}{RT_{T1}}} \sqrt{\frac{T_1}{T_{T1}}}}{\mu_1} \quad C$$

Suction surface incidence i_{SS}

$$i_{SS} = \beta_1 - \kappa_{SS_{LE}}$$

Mean line incidence $i_{ML_{LE}}$

$$i_{ML} = \beta_1 - \kappa_{ML_{LE}}$$

3. CASCADE IDEAL PERFORMANCE

The cascade ideal performance calculations employ sidewall static pressure taps at the cascade exit to assess the uniformity of the flow field and relate exit to inlet flow properties to establish the test condition.

Mean exit sidewall static pressure P_{2A}

$$P_{2A} = \frac{n}{\sum_{i=1}} \frac{P_i}{n}$$

where: P_i = Sidewall static pressure,

n = Number of sidewall static taps

RMS deviation of sidewall static taps RMS

$$RMS = \sqrt{\frac{\sum_{i=1}^n (P_{2A} - P_i)^2}{n}}$$

where: P_i = Sidewall static pressure

n = Number of sidewall static taps

Ideal exit Mach number Mn_{2ID}

$$Mn_{2ID} = \left[\frac{2}{k-1} \left\{ \left(\frac{P_{T1}}{P_{2A}} \right)^{\frac{k-1}{k}} - 1 \right\} \right]^{\frac{1}{2}}$$

Ideal static pressure ratio P_{RID}

$$P_{RID} = \frac{P_{2A}}{P_1}$$

4. BLADE TRAILING EDGE PRESSURES

Mean trailing edge pressure P_{TEA}

$$P_{TEA} = \frac{\sum_{i=1}^n P_i}{n}$$

where: P_i = Trailing edge static pressure

n = Number of trailing edge static taps

RMS deviation of trailing edge pressures RMS

$$RMS = \sqrt{\frac{\sum_{i=1}^n (P_{TEA} - P_i)^2}{n}}$$

where: P_i = Trailing edge static pressure

n = Number of trailing edge static taps

5. INSTRUMENTED BLADE PARAMETERS

Local static pressure rise parameter S

$$S = \frac{P_L - P_1}{Q_1}$$

where: P_L = local surface static pressure, PSIA

Local surface pressure ratio $\frac{P_L}{P_T}$

$$\frac{P_L}{P_T} = \frac{P_{L1}}{P_{T1}}$$

Surface static pressure tap location $\% C_i$

Referring to Figure 19, one can determine the location of the blade surface static pressure taps on either the pressure or suction surface as follows:

$$\alpha_i = \tan^{-1} \left(\frac{Y_i}{X_i} \right)$$

$$\%C_i = \frac{\cos(\alpha_i - \gamma)}{C} \sqrt{X_i^2 + Y_i^2} \quad (100)$$

Blade forces and moments

Figure 20 shows the coordinate system used for the identification of the surface static pressure taps along with the nomenclature and assumed directions for the calculations. Calculation of the blade forces due to the surface static pressure distribution can be completed systematically over the blade surface between the first and last static pressure taps. Treatment of that portion of the blade surface between the leading edge and first static pressure tap, as well as the surface between the last static tap and the trailing edge, depends either on estimation of the pressure distribution on those surfaces or on certain simplifying assumptions with regard to the leading and trailing edge pressures. This report assumes that at the leading edge the pressure on the pressure surface is equal to the pressure on the suction surface. The same assumption is made at the trailing

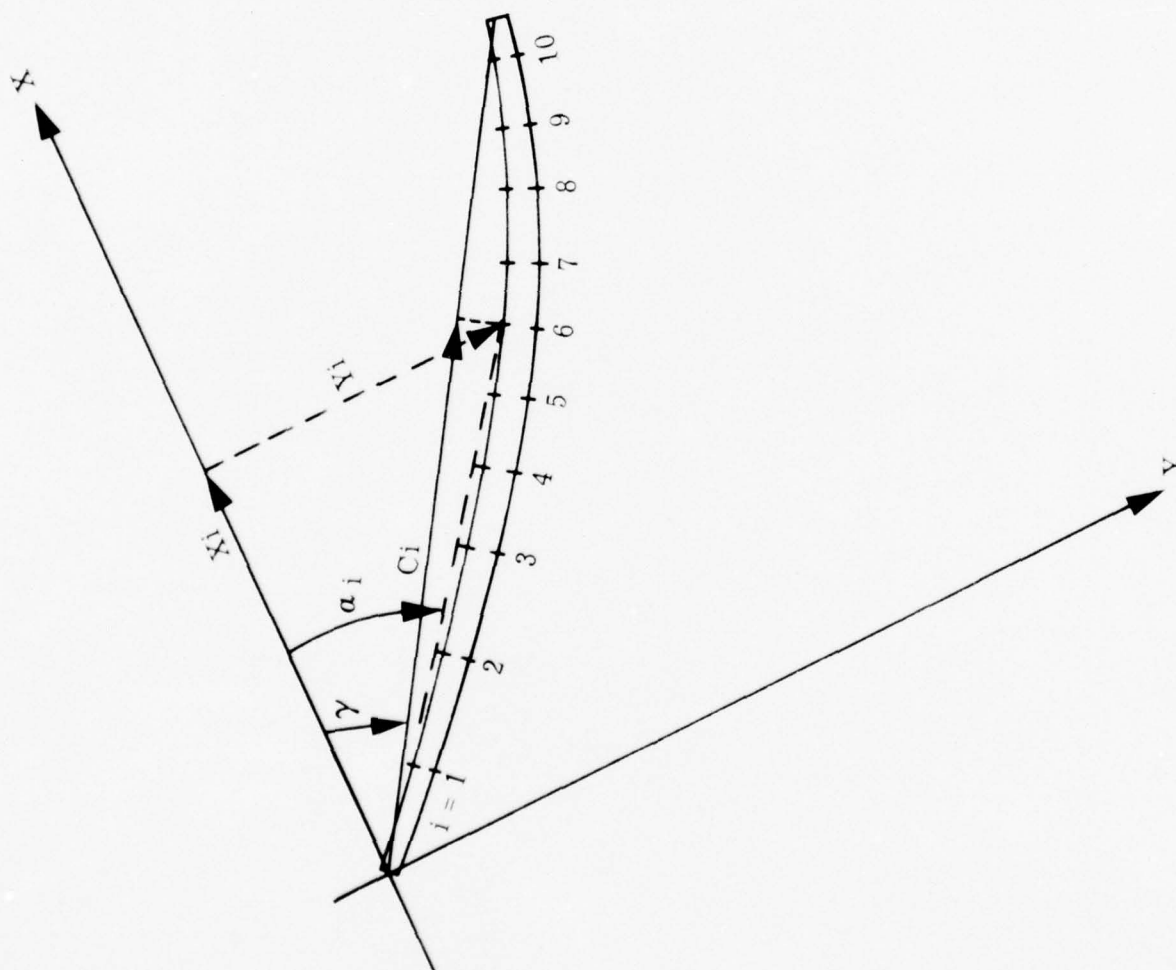


FIGURE 19. SURFACE STATIC PRESSURE TAP LOCATIONS

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edge. Furthermore, if the pressure force between the leading edge and the first static port acts on an area equivalent to the average of the pressure and suction surface areas orientated at an average surface inclination, the leading edge pressure cancels in the force summation. The same is true for the trailing edge.

The force on the blade between the leading edge and first static pressure tap is determined by:

$$\begin{aligned}
 F_{LE} &= F_{LE_{PS}} - F_{LE_{SS}} \\
 &= \left(\frac{P_{1_{PS}} - P_{1_{SS}}}{2} \right) A_{S_{LE}} \\
 \text{where: } A_{S_{LE}} &= \frac{\{[(X_1 - X_{LE})^2 + (Y_1 - Y_{LE})^2]^{\frac{1}{2}} \left(\frac{B_1 + B_{LE}}{2} \right)\}_{PS}}{2} \\
 &\quad + \frac{\{[(X_1 - X_{LE})^2 + (Y_1 - Y_{LE})^2]^{\frac{1}{2}} \left(\frac{B_1 + B_{LE}}{2} \right)\}_{SS}}{2}
 \end{aligned}$$

The average surface angle between the leading edge and the first static pressure tap is:

$$\beta_{LE} = \frac{\tan^{-1} \left[\frac{Y_1 - Y_{LE}}{X_1 - X_{LE}} \right]_{PS} + \tan^{-1} \left[\frac{Y_1 - Y_{LE}}{X_1 - X_{LE}} \right]_{SS}}{2}$$

The same relations can be employed at the blade trailing edge:

$$\begin{aligned}
 F_{TE} &= F_{TE_{PS}} - F_{TE_{SS}} \\
 &= \left(\frac{P_{n_{PS}} - P_{n_{SS}}}{2} \right) A_{S_{TE}}
 \end{aligned}$$

$$\text{where: } A_{S_{TE}} = \frac{\{[(X_{TE} - X_n)^2 + (Y_{TE} - Y_n)^2]^{\frac{1}{2}} (\frac{B_{TE} + B_n}{2})\}_{PS}}{2} \\ + \frac{\{[(X_{TE} - X_n)^2 + (Y_{TE} - Y_n)^2]^{\frac{1}{2}} (\frac{B_{TE} + B_n}{2})\}_{SS}}{2}$$

and

$$\beta_{TE} = \frac{\tan^{-1} \left[\frac{Y_{TE} - Y_n}{X_{TE} - X_n} \right]_{PS} + \tan^{-1} \left[\frac{Y_{TE} - Y_n}{X_{TE} - X_n} \right]_{SS}}{2}$$

where: n = total number of surface static taps

The force exerted on the nose of the blade due to the pressure distribution on the circular leading edge is currently estimated by:

$$F_{LEN} = r P_{T1} \left[1 + \frac{\cos(\pi\alpha)}{1-4\alpha} \right] B_1$$

$$\text{where: } \alpha = .109216 \ln Mn_1 + .785717$$

The force on the nose of the blade is assumed to act in a direction parallel to the mean camber line at the blade leading edge.

Even though classical methods of derivation have been used in deriving the coefficient of drag, it will be noticed in the data that small negative values of drag were measured. It is believed that this is due to an underestimation of the bow wave force.

The total axial force on the blade is now determined by:

$$F_X = \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \sin \beta \right]_{SS} - \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \sin \beta \right]_{PS} \\ - F_{LE} \sin \beta_{LE} - F_{TE} \sin \beta_{TE} + F_{LEN} \cos \beta_{ML_{LE}}$$

$$\text{where: } A_S = \Delta l \left[\frac{B_i + B_{i+1}}{2} \right]$$

$$\Delta l = [(X_{i+1} - X_i)^2 + (Y_{i+1} - Y_i)^2]^{\frac{1}{2}}$$

$$\beta = \tan^{-1} \left[\frac{(Y_{i+1} - Y_i)}{(X_{i+1} - X_i)} \right]$$

$\beta_{ML_{LE}}$ = mean line blade metal angle at the leading edge, degrees

n = number of surface static pressure taps

Similarly, the total tangential force on the blade is:

$$F_Y = \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \cos \beta \right]_{PS} - \sum_{i=1}^{n-1} \left[\left(\frac{P_i + P_{i+1}}{2} \right) A_S \cos \beta \right]_{SS}$$

$$+ F_{LE} \cos \beta_{LE} + F_{TE} \cos \beta_{TE} + F_{LEN} \sin \beta_{ML_{LE}}$$

The resultant force on the blade is calculated as:

$$F_R = \sqrt{F_X^2 + F_Y^2}$$

The direction of the resultant force is:

$$\beta_F = \tan^{-1} \left(\frac{F_Y}{F_X} \right)$$

Referring again to Figure 20 one determines the moment exerted on the blade assuming clockwise rotation positive and calculated from the leading edge from the relation:

$$\begin{aligned}
M_{LE} = & \sum_{i=1}^{n-1} [F_{X_i} \left(\frac{Y_{i+1} + Y_i}{2} \right) + F_{Y_i} \left(\frac{X_{i+1} + X_i}{2} \right)]_{PS} \\
& - \sum_{i=1}^{n-1} [F_{X_i} \left(\frac{Y_{i+1} + Y_i}{2} \right) + F_{Y_i} \left(\frac{X_{i+1} + X_i}{2} \right)]_{SS} + F_{LE} \sin \beta_{LE} \left(\frac{Y_{LE} + Y_1}{2} \right) \\
& + F_{TE} \sin \beta_{TE} \left(\frac{Y_n + Y_{TE}}{2} \right) + F_{LE} \cos \beta_{LE} \left(\frac{X_{LE} + X_1}{2} \right) \\
& + F_{TE} \cos \beta_{TE} \left(\frac{X_n + X_{TE}}{2} \right)
\end{aligned}$$

The nondimensionalized force coefficients are determined by **dividing** the force by the product of inlet dynamic pressure, blade span, and blade chord. For cascades where the blade span is not constant, the average of the blade inlet and exit span is used.

Axial force coefficient F_{C_X}

$$F_{C_X} = \frac{F_X}{Q_1 \left(\frac{B_1 + B_2}{2} \right) C}$$

Tangential force coefficient F_{C_Y}

$$F_{C_Y} = \frac{F_Y}{Q_1 \left(\frac{B_1 + B_2}{2} \right) C}$$

Resultant force coefficient F_{C_R}

$$F_{C_R} = \frac{F_R}{Q_1 \left(\frac{B_1 + B_2}{2} \right) C}$$

The nondimensionalized moment coefficient is determined by **dividing** the moment by the product of inlet dynamic pressure, blade span, and blade chord squared. Again the average of the blade inlet and exit span is used when the blade span is not constant.

Moment coefficient $M_{C_{LE}}$

$$M_{C_{LE}} = \frac{M_{LE}}{Q_1 \left(\frac{B_1 + B_2}{2} \right) C^2}$$

Drag coefficient C_{D_1}

The drag coefficient is calculated by assuming the drag force acts parallel to the blade chord:

$$C_{D_1} = F_{C_R} \cos (180 - \gamma + \beta_F)$$

Lift coefficient C_{L_1}

The lift coefficient is calculated by assuming the lift force acts perpendicular to the blade chord:

$$C_{L_1} = F_{C_R} \sin (180 - \gamma + \beta_F)$$

Center of pressure $C_{P_{LE}}$

The center of pressure is determined as percent of chord from the blade leading edge:

$$C_{P_{LE}} = \frac{M_{LE}}{F_R C} (100)$$

6. INSTRUMENTED SPLITTER VANE PARAMETERS

Local static pressure rise parameter S

$$S = \frac{P_L - P_1}{Q_1}$$

where: P_L = local surface static pressure, PSIA

Local surface pressure ratio $\frac{P_L}{P_T}$

$$\frac{P_L}{P_T} = \frac{P_L}{P_{T_1}}$$

7. CASCADE LOCAL EXIT PERFORMANCE

The local cascade exit conditions are determined by positioning a five port conical probe at discrete points across the cascade passage. The conical probe has been calibrated over a Mach number range of .35 to 1.80 at various incidence angles. The conical probe calibration procedure is discussed in Reference 7. Using the calibration data, the wind tunnel on-line data acquisition system determines the flow Mach number (Mn_2), flow total pressure (P_{T_2}), and flow direction relative to the conical probe centerline (β_P) at each discrete point at the cascade exit. The local exit flow direction referenced to the engine axial direction (β_2) is determined by:

$$\beta_2 = 90 - \psi_P + \beta_P$$

where: ψ_P = Probe angle (angle between probe centerline and engine tangential direction), degrees

Knowing the local exit Mach number, total pressure, and flow direction, one calculates the following local performance parameters.

Local exit axial Mach number Mn_{X_2}

$$Mn_{X_2} = Mn_2 \cos \beta_2$$

Local exit tangential Mach number Mn_{Y_2}

$$Mn_{Y_2} = Mn_2 \sin \beta_2$$

Local exit static pressure P_2

$$P_2 = \frac{P_{T_2}}{\left(1 + \frac{k-1}{2} Mn_2^2\right)^{\frac{k}{k-1}}}$$

Local exit total pressure recovery P_{R_T}

$$P_{R_T} = \frac{P_{T_2}}{P_{T_1}}$$

Local exit deviation angle δ°

$$\delta^\circ = \beta_2 - \kappa_{ML_{TE}}$$

where: $\kappa_{ML_{TE}}$ = mean line blade metal angle
at the trailing edge, degrees

Local exit turning angle $\Delta\beta$

$$\Delta\beta = \beta_1 - \beta_2$$

Local exit total temperature T_{T_2}

$$T_{T_2} = T_{T_1}$$

Local exit total to static temperature ratio $\frac{T_{T_2}}{T_2}$

$$\frac{T_{T_2}}{T_2} = 1 + \frac{k-1}{2} Mn_2^2$$

Local exit mass flow rate per inch span m_2

$$m_2 = \frac{[(P_2^{Mn} X_2 \sqrt{\frac{kg}{RT_{T_2}}} \sqrt{\frac{T_{T_2}}{T_2}})_i + (P_2^{Mn} X_2 \sqrt{\frac{kg}{RT_{T_2}}} \sqrt{\frac{T_{T_2}}{T_2}})_{i+1}](Y_{i+1} - Y_i)}{2}$$

where: Y = Conical probe tip tangential
location, inches

i = Discrete point at which conical
probe measurements are taken

Local exit flow velocity V_2

$$V_2 = Mn_2 \sqrt{kgRT_{T_2}} \sqrt{\frac{T_2}{T_{T_2}}}$$

8. MASS-AVERAGED CASCADE EXIT CONDITIONS

The mass-averaged cascade exit conditions are determined by mass-averaging of the local exit data (Mach number, flow angle, and total pressure recovery) using the relationship:

$$\langle f \rangle = \frac{\sum_{i=1}^{n-1} \left[f_i P_i^{Mn_{X,i}} \sqrt{\frac{T_T}{T}_i} + f_{i+1} P_{i+1}^{Mn_{X,i+1}} \sqrt{\frac{T_T}{T}_{i+1}} \right] (Y_{i+1} - Y_i)}{\sum_{i=1}^{n-1} \left[P_i^{Mn_{X,i}} \sqrt{\frac{T_T}{T}_i} + P_{i+1}^{Mn_{X,i+1}} \sqrt{\frac{T_T}{T}_{i+1}} \right] (Y_{i+1} - Y_i)}$$

where

- i = Probe measurement station
- n = Total number of points
- f_i = Discrete data to be mass-averaged
- P_i = Local static pressure, psi
- $Mn_{X,i}$ = Local axial Mach number
- T_T/T_i = Local total to static temperature ratio
- Y_i = Conical probe tip location in tangential direction, in.
- $\langle f \rangle$ = Mass averaged variable

The following cascade exit parameters can be determined from the mass-averaged exit conditions.

Mass-averaged axial Mach number Mn_{X_2}

$$Mn_{X_2} = Mn_2 \cos \beta_2$$

Mass-averaged tangential Mach number Mn_{Y_2}

$$Mn_{Y_2} = Mn_2 \sin \beta_2$$

Mass-average total pressure P_{T_2}

$$P_{T_2} = (P_{T_1}) P_{R_T}$$

Mass-averaged static pressure P_2

$$P_2 = \frac{P_{T_2}}{\left[1 + \frac{k-1}{2} Mn_2^2\right]^{\frac{k}{k-1}}}$$

Mass-averaged total temperature T_{T_2}

$$T_{T_2} = T_{T_1}$$

Mass-averaged total to static temperature ratio $\frac{T_{T_2}}{T_2}$

$$\frac{T_{T_2}}{T_2} = 1 + \frac{k-1}{2} Mn_2^2$$

Exit to inlet mass ratio $\frac{m_2}{m_1}$

$$\frac{m_2}{m_1} = \frac{P_2 Mn_{X_2} \sqrt{\frac{k g}{RT_{T_2}}} \sqrt{\frac{T_{T_2}}{T_2}} s}{m_1 \left(\frac{B_2}{B_1 P}\right)}$$

where: s = Blade spacing, in.

$\left(\frac{B_2}{B_1 P}\right)$ = Exit to inlet span ratio at the probe measuring station

9. MIXED EXIT CONDITIONS

The local cascade exit discrete data can be "mixed-out" using the conservation equations of one-dimensional gas dynamics to obtain the cascade exit properties in terms of a uniform exit flow field. The technique and applicable relationships for "mixing-out" the cascade discrete data are presented in Reference 8. The results of the mixing equations are the "mixed-out" Mach number (Mn_2), flow angle (β_2), total pressure (P_{T_2}), and total temperature (T_{T_2}). From these four mixed exit properties, additional cascade exit performance parameters such as those described for the mass-averaged exit conditions can be determined.

10. CASCADE OVERALL PERFORMANCE

The cascade overall performance parameters for either mass-averaged or mixed exit conditions are presented below.

Static pressure ratio P_R

$$P_R = \frac{P_2}{P_1}$$

Total pressure recovery P_{R_T}

$$P_{R_T} = \frac{P_{T_2}}{P_{T_1}}$$

Velocity ratio $\frac{V_2}{V_1}$

$$\frac{V_2}{V_1} = \frac{Mn_2 \sqrt{\frac{T_2}{T_{T_2}}}}{Mn_1 \sqrt{\frac{T_1}{T_{T_1}}}}$$

assuming $T_{T_2} = T_{T_1}$

Axial velocity ratio $\frac{V_{X_2}}{V_{X_1}}$

$$\frac{V_{X_2}}{V_{X_1}} = \left(\frac{V_2}{V_1}\right) \frac{\cos \beta_2}{\cos \beta_1}$$

Tangential velocity ratio $\frac{V_{Y_2}}{V_{Y_1}}$

$$\frac{V_{Y_2}}{V_{Y_1}} = \left(\frac{V_2}{V_1}\right) \frac{\sin \beta_2}{\sin \beta_1}$$

Density ratio $\frac{\rho_2}{\rho_1}$

$$\frac{\rho_2}{\rho_1} = \left(\frac{P_2}{P_1}\right) \left(\frac{\frac{T_{T2}}{T_2}}{\frac{T_{T1}}{T_1}}\right)$$

assuming $T_{T2} = T_{T1}$

Static temperature ratio $\frac{T_2}{T_1}$

$$\frac{T_2}{T_1} = \frac{T_{T2}}{T_{T1}} \left(\frac{1 + \frac{k-1}{2} Mn_1^2}{1 + \frac{k-1}{2} Mn_2^2} \right)$$

Total pressure loss coefficient ω

$$\omega = \frac{P_{T1} - P_{T2}}{P_{T1} - P_1}$$

Total pressure loss parameter ω_p

$$\omega_p = \frac{\omega \cos \beta_2 s}{2 C}$$

Diffusion factor D_f

$$D_f = 1 - \frac{V_2}{V_1} + \frac{\sin \beta_1 s}{2 C} \left(1 - \frac{V_{Y2}}{V_{Y1}}\right)$$

Equivalent diffusion factor

$$D_{f_{eq}} = \frac{V_1}{V_2} \left[1.12 + .61 \frac{\cos^2 \beta_1 s}{C} \left(\tan \beta_1 - \frac{V_{X_2}}{V_{X_1}} \tan \beta_2 \right) \right]$$

Tangential velocity change $\frac{\Delta V_Y}{V_1}$

$$\frac{\Delta V_Y}{V_1} = \left(1 - \frac{V_{Y_2}}{V_{Y_1}} \right) \sin \beta_1$$

Reynolds number N_R

$$N_R = \frac{12 P_2 Mn_2 \sqrt{\frac{k g}{RT_2}} \sqrt{\frac{T_{T_2}}{T_2}}}{\mu_2} C$$

Static pressure rise parameter S

$$S = \frac{P_2 - P_1}{Q_1}$$

Deviation angle δ°

$$\delta^\circ = \beta_2 - \kappa_{ML_{TE}}$$

Turning angle $\Delta \beta$

$$\Delta \beta = \beta_1 - \beta_2$$

Exit flow direction based on continuity β_C

$$\beta_C = \cos^{-1} \left[\left(\frac{\rho_1}{\rho_2} \right) \left(\frac{V_1}{V_2} \right) \left(\frac{B_1}{B_2} \right) \cos \beta_1 \right]$$

Flow area ratio based on continuity $\frac{A_2}{A_1}$

$$\frac{A_2}{A_1} = \left(\frac{\rho_1}{\rho_2} \right) \left(\frac{V_{X1}}{V_{X2}} \right)$$

APPENDIX B
COMPUTER PRINT-OUT IDENTIFICATION

The supersonic wind tunnel on-line instrumentation system yields eleven pages of computer print-out describing the cascade aerodynamic performance for each test condition. This Appendix briefly describes the contents of the computer print-out, the nomenclature used, and provides tables to simplify the location and identification of selected cascade data items. The computer print-out nomenclature is shown in Table XV.

On the first page of the print-out following the title lines, five entries appear which describe the test point operating conditions: splitter vane setting angle, cascade inlet Mach number, cascade ideal static pressure ratio, the cascade blade behind which the conical probe data was taken, and the conical probe axial location behind the blade row.

The second entry on the first page of print-out presents miscellaneous test section data including the conical probe position in the exit flow field, test section angular position, and the wind tunnel total temperature.

The last entry on the first page describes the flow properties across a sharp leading edge wedge which is used to expand or compress the nozzle exit flow to establish the cascade inlet Mach number and flow direction.

The second page of computer print-out presents a listing of the pressures measured on the four Scanivalves and the splitter vane physical design parameters. Tables XVI and XVII identify the pressures by Scanivalve and port number. The first seven ports of each Scanivalve are used for reference calibration pressures with alternate ports thereafter connected to a vacuum source to eliminate transducer hysteresis and minimize pneumatic settling time. From these pressures, the cascade performance presented on the fourth through seventh pages of the print-out are determined.

The first entry on the third page of the print-out consists of two lines describing the cascade physical design parameters. The second entry presents the nozzle exit flow field properties. Identification of these items are presented in Table XVIII.

The last entry on the third page describes the cascade inlet flow field conditions. Identification of the cascade inlet parameters are presented in Table XIX.

The first entry on the fourth page of the computer print-out is the cascade ideal performance based on sidewall static pressures. Included is a listing of the pressures presented on the second page of the print-out for the sidewall static pressure taps. From these pressures, a mean exit static pressure and RMS deviation are calculated along with the same parameters for the mid-passage static pressure taps. The cascade ideal exit Mach number and ideal static pressure ratio are determined from the mean exit static pressure.

APPENDIX B
COMPUTER PRINT-OUT IDENTIFICATION

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GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/6 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER F33615-76-C-2052

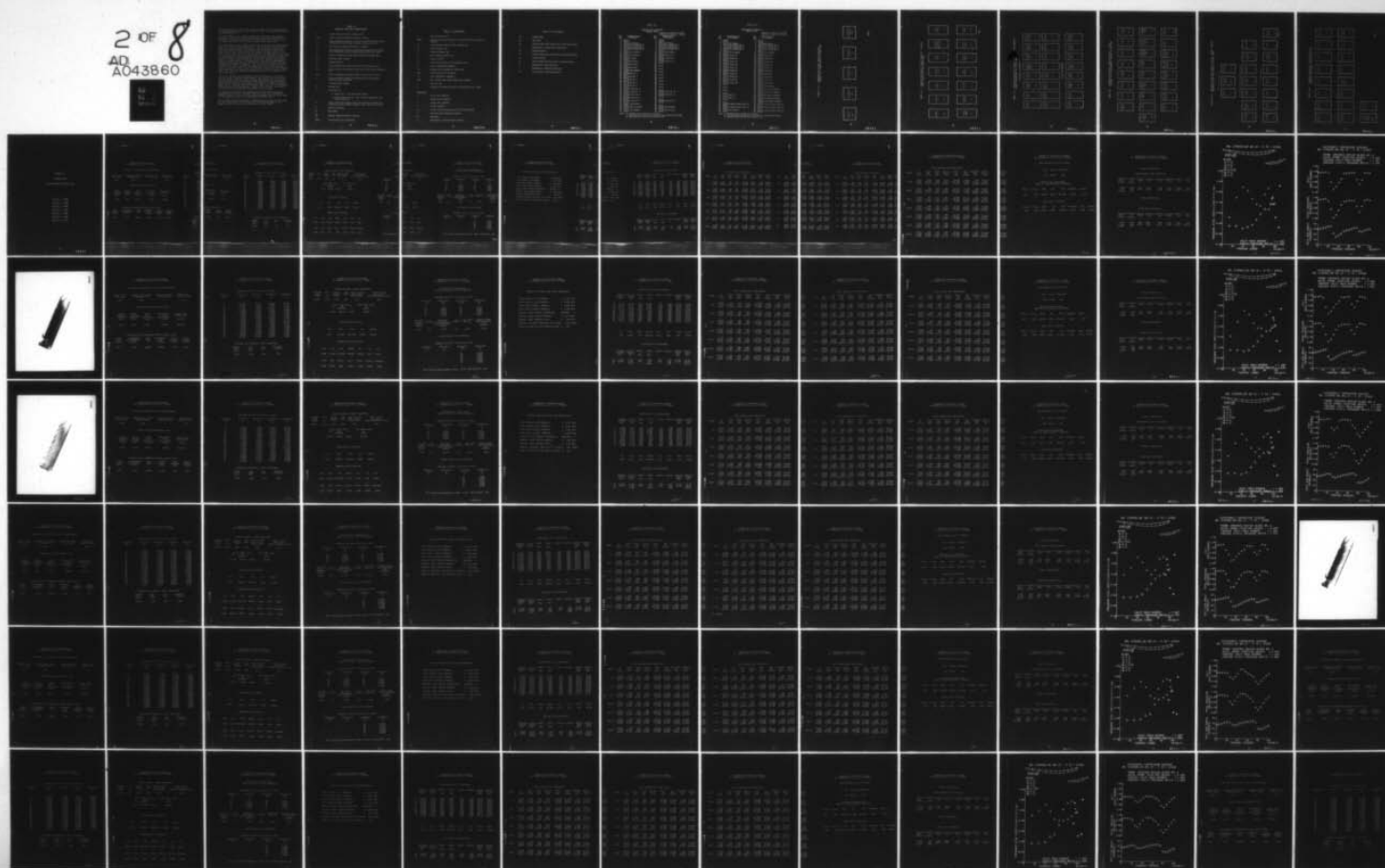
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2 OF 8
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The second entry on the fourth page consists of the cascade blade trailing edge pressures, the arithmetic mean of these pressures and the RMS deviation.

The fifth page of the computer print-out describes the sidewall boundary layer bleed system performance including sidewall slot pressures, sidewall boundary layer bleed flow rate, and the ratio of bleed mass flow rate to total cascade inlet mass flow.

The sixth page of the computer print-out describes the instrumented blade and splitter vane parameters. The first entry presents the static pressure distribution on the cascade blade surface along with associated columns describing local performance characteristics and static tap locations in terms of percent chord. The last item in each column is for the blade trailing edge static taps. The trailing edge static pressure used in the calculations was based on the average of the measured trailing edge pressures in blade numbers 4 and 5 (instrumented on the suction surface and pressure surface, respectively). Following the local surface performance characteristics are several additional parameters summarizing the instrumented blade performance. The last entry on the sixth page presents the static pressure distribution on the splitter vane surface along with associated columns describing local performance characteristics and static tap locations in terms of percent chord. Table XX provides additional identification of the entries on the sixth page.

The local cascade exit performance was determined by utilizing a conical probe to measure Mach number, flow angle, and total pressure at twenty discrete points across one passage of the cascade. The probe was positioned behind blade number 4 and measurements were taken in five percent steps. The seventh, eighth, and ninth pages of the computer print-out present the local exit performance characteristics of the cascade. Table XXI provides the identification for the parameters presented on these pages.

The cascade exit flow field properties are determined by mass-averaging and mixing to uniform flow the local exit parameters. Identification of the exit flow field parameters on the tenth page of the computer print-out is presented in Table XXII.

The cascade overall performance characteristics relating the inlet and exit properties are presented on the eleventh page of the computer print-out and are identified in Table XXIII.

TABLE XV
COMPUTER PRINT-OUT NOMENCLATURE

A	Cascade flow area (span X spacing), in ²
BETA	Angle, measured from axial direction, degrees
CD	Drag coefficient (drag force referenced parallel to blade chord normalized by inlet dynamic pressure, span, and chord)
C)F	Skin friction coefficient times one thousand
CL	Lift coefficient (lift force referenced perpendicular to blade chord normalized by inlet dynamic pressure, span, and chord)
CP	Center of pressure, percent chord from blade leading edge
DEV	Deviation angle, degrees
DF	Diffusion Factor
DP	Total pressure loss (inlet minus exit total pressure), psi
DPS	Static pressure rise (local or exit minus inlet static pressure), psi
DV)Y	Ratio of tangential velocity change to inlet total velocity
FC	Force coefficient (blade force normalized by inlet dynamic pressure, span, and chord)
I	Incidence angle, degrees
LE	Leading edge
M	Mass flow rate <ul style="list-style-type: none"> • Nozzle exit - total mass flow, lbs/sec • Cascade inlet and exit - mass flow per passage per inch span, lbs/sec-in.
MC	Moment coefficient (moment exerted on blade about leading edge normalized by inlet dynamic pressure, span, and chord squared)
ML	Mean line reference
MN	Mach number
NR) RN	Reynolds number divided by 1 million
OMEGA	Total pressure loss coefficient

TABLE XV (CONTINUED)

P	Static pressure, psi
PERCT	Tangential reference position of conical probe tip, percent of passage
PS	Local pressure surface static pressure, psi
PT	Total pressure, psi
Q	Dynamic pressure, psi
Q1	Inlet dynamic pressure, psi
R	Density, lb/ft ³
SS	Local suction surface static pressure, psi
T	Static temperature, degrees R
T/C	Maximum blade thickness to chord ratio
TPLP	Total pressure loss parameter
TT	Total temperature, degrees R
TURN	Flow turning angle (inlet minus exit), degrees
V	Velocity, fps
Y	Tangential reference position of conical probe tip, inches

Subscripts:

0	Nozzle exit condition
1	Cascade inlet condition
2	Cascade exit condition
A	Average condition
BP	Conical probe bottom static port in vertical plane
C	Calculated from continuity equation
EQ	Equivalent
F	Referenced to resultant force direction

TABLE XV (CONTINUED)

LE	Leading edge
ML	Mean line
NP	Conical probe north static port in horizontal plane
P	Referenced to conical probe centerline
PS	Pressure surface
SP	Conical probe south static port in horizontal plane
SS	Suction surface
TP	Conical probe top static port in vertical plane
X	Referenced to axial direction
Y	Referenced to tangential direction
YP	Conical probe total pressure port

TABLE XVI

SCANIVALVE PORT ASSIGNMENTS
(PROGRAM COMP3)

		Calibration Pressure #1 = 10 psi Calibration Pressure #2 = 20 psi	
<u>Port No.</u>	<u>Scanivalve No. 3</u> (0-30 psi)	<u>Port No.</u>	<u>Scanivalve No. 2</u> (0-15 psi)
1	Vacuum	1	Vacuum
2	Vacuum	2	Vacuum
3	Calibration Vacuum	3	Calibration Vacuum
4	Calibration Pressure No. 1	4	Calibration Pressure No. 1
5	Calibration Pressure No. 1	5	Calibration Pressure No. 1
6	Calibration Pressure No. 2	6	Calibration Pressure No. 2
7	Calibration Pressure No. 2	7	Calibration Pressure No. 2
8	Vacuum	8	Vacuum
9	Tunnel Total Pressure	9	Tunnel Total Pressure
10	Vacuum	10	Vacuum
11	Probe Total Pressure	11	Passage Static No. 1
12	Vacuum	12	Vacuum
13	Probe Top Static	13	Passage Static No. 2
14	Vacuum	14	Vacuum
15	Probe Bottom Static	15	Passage Static No. 3
16	Vacuum	16	Vacuum
17	Probe North Static	17	
18	Vacuum	18	Vacuum
19	Probe South Static	19	
20	Vacuum	20	Vacuum
21	Tunnel Total Pressure	21	
22	Vacuum	22	Vacuum
23	Exit Static No. 1	23	
24	Vacuum	24	Vacuum
25	Exit Static No. 2	25	
26	Vacuum	26	Vacuum
27	Exit Static No. 3	27	
28	Vacuum	28	Vacuum
29	Exit Static No. 4	29	
30	Vacuum	30	Vacuum
31	Exit Static No. 5	31	
32	Vacuum	32	Vacuum
33	Mid-chnl Static No. 1	33	
34	Vacuum	34	Vacuum
35	Mid-chnl Static No. 2	35	Passage Static No. 10
36	Vacuum	36	Vacuum
37	Mid-chnl Static No. 3	37	Passage Static No. 11
38	Vacuum	38	Vacuum
39	Mid-chnl Static No. 4	39	
40	Vacuum	40	Vacuum
41	Mid-chnl Static No. 5	41	Passage Static No. 12
42	Vacuum	42	Vacuum
43	Tunnel Total Pressure	43	
44	Vacuum	44	Vacuum
45	Primary Ejector Pressure	45	Tunnel Total Pressure
46	Vacuum	46	Vacuum
47	Tunnel Total Pressure	47	Tunnel Total Pressure
48	Vacuum	48	Vacuum

NOTES: 1) Sidewall Statics Numbered Front to Back
 2) All Probe Taps to be Plumbed Straight through Scanivalve Patch Panel
 3) Remove Roll Pins and Felt from all Ports Used

TABLE XVII

SCANIVALVE PORT ASSIGNMENTS
(PROGRAM COMP3)Calibration Pressur #1 = 10 psi
Calibration Pressure #2 = 20 psi

Port No.	Scanivalve No. 4 (0 - 50 psi)	Port No.	Scanivalve No. 1 (0 - 15 psi)
1	Vacuum	1	Vacuum
2	Vacuum	2	Vacuum
3	Calibration Vacuum	3	Calibration Vacuum
4	Calibration Pressure No. 1	4	Calibration Pressure No. 1
5	Calibration Pressure No. 1	5	Calibration Pressure No. 1
6	Calibration Pressure No. 2	6	Calibration Pressure No. 2
7	Calibration Pressure No. 2	7	Calibration Pressure No. 2
8	Vacuum	8	Vacuum
9	Tunnel Total Pressure	9	Tunnel Total Pressure
10	Vacuum	10	Vacuum
11	Blade PS Static #1	11	Blade SS Static #1
12	Vacuum	12	Vacuum
13	Blade PS Static #2	13	Blade SS Static #2
14	Vacuum	14	Vacuum
15	Blade PS Static #3	15	Blade SS Static #3
16	Vacuum	16	Vacuum
17	Blade PS Static #4	17	Blade SS Static #4
18	Vacuum	18	Vacuum
19	Blade PS Static #5	19	Blade SS Static #5
20	Vacuum	20	Vacuum
21	Blade PS Static #6	21	Blade SS Static #6
22	Vacuum	22	Vacuum
23	Blade PS Static #7	23	Blade SS Static #7
24	Vacuum	24	Vacuum
25	Blade PS Static #8	25	Blade SS Static #8
26	Vacuum	26	Vacuum
27	Blade PS Static #9	27	Blade SS Static #9
28	Vacuum	28	Vacuum
29	Blade PS Static #10	29	Blade SS Static #10
30	Vacuum	30	Vacuum
31		31	Tunnel Total Pressure
32	Vacuum	32	Vacuum
33		33	North Sidewall Slot Pressure
34	Vacuum	34	Vacuum
35		35	South Sidewall Slot Pressure
36	Vacuum	36	Vacuum
37	T. E. Static # 4	37	North Bleed Manifold Pressure
38	Vacuum	38	Vacuum
39	T. E. Static # 5	39	South Bleed Manifold Pressure
40	Vacuum	40	Vacuum
41		41	Upstream Bleed Orifice Pressure
42	Vacuum	42	Vacuum
43	Splitter Pressure Surface Static #1	43	Splitter Suction Surface Static #1
44	Vacuum	44	Vacuum
45	Splitter Pressure Surface Static #2	45	Splitter Suction Surface Static #2
46	Vacuum	46	Vacuum
47	Tunnel Total Pressure	47	Splitter Suction Surface Static #3
48	Vacuum	48	Vacuum

NOTE: 1) Sidewall Statics Numbered Front to Back
 2) All Probe Taps to be Plumbed Straight through Scanivalve Patch Panel
 3) Remove Roll Pins and Felt from all Ports Used

TABLE XVIII. COMPUTER PRINT-OUT IDENTIFICATION -
NOZZLE EXIT CONDITIONS ON THIRD PAGE

Nozzle Exit
Flow Direction
(Degrees)
BETA)0

Nozzle Exit
Total Mass Flow
(lbs/sec)
MN)0

Nozzle Exit
Total Temperature
(°R)
TT)0

Nozzle Exit
Total Pressure
(psi)
PT)0

Nozzle Exit
Mach No.
MN)0

288706

TABLE XIX. COMPUTER PRINT-OUT IDENTIFICATION - CASCADE
INLET CONDITIONS ON THIRD PAGE

Inlet Mach Number MN)1	Inlet Total Pressure (psi) PT)1	Inlet Total Temperature (°R) TT)1	Inlet Flow Direction (Degrees) BETA)1	Inlet Static Pressure (psi) P)1	Inlet Mass Flow Rate per inch span (lb/sec-in) M)1	Inlet Dynamic Pressure (psi) Q)1
Suction Surface Incidence (Degrees) I)SS	Mean Line Incidence (Degrees) I)ML	Inlet Axial Mach Number MN)X,1	Inlet Tangential Mach Number MN)Y,1	Inlet Total to Static Temperature Ratio TT/T)1	Inlet Total to Static Pressure Ratio PT/P)1	Inlet Reynolds Number NR/10**6

288707

TABLE XX. COMPUTER PRINT-OUT IDENTIFICATION - INSTRUMENTED
BLADE PARAMETERS ON SIXTH PAGE

INSTRUMENTED BLADE PARAMETERS

Local Pressure Surface Static Pressure (psi)	PS	Local Suction Surface Static Pressure (psi)	SS	Local Static Pressure Rise Parameter- Suction Surface	DPS/Q1 (PS)	Ratio of Local Static Pressure to Inlet Total Pressure- Pressure- Suction Surface	DPS/Q1 (SS)	Ratio of Local Static Pressure to Inlet Total Pressure - Suction Surface	PS/PT)1	Static Port Location - 1 Chord from Leading Edge Suction Surface	PS	Static Port Location - 2 Chord from Leading Edge Suction Surface	SS		
Resultant Force Coefficient	FC	Axial Force Coefficient	FC/X	Tangential Force Coefficient	FC/Y	Resultant Force Direction (Degrees)	BETA)F	Drag Coefficient	CD)1	Lift Coefficient	CL)1	Moment Coefficient	MC)LE	Center of Pressure -	CP)LE

SPLITTER VANE PARAMETERS

Local Pressure Surface Static Pressure (psi)	PS	Local Suction Surface Static Pressure (psi)	SS	Local Static Pressure Rise Parameter- Suction Surface	DPS/Q1 (PS)	Ratio of Local Static Pressure to Inlet Total Pressure- Pressure- Suction Surface	PS/PT)1	Ratio of Local Static Pressure to Inlet Total Pressure - Suction Surface	SS/PT)1	Static Port Location - 1 Chord from Leading Edge Pressure Surface	PS	Static Port Location - 2 Chord from Leading Edge Suction Surface	SS
---	----	--	----	---	----------------	--	---------	---	---------	--	----	---	----

TABLE XXI. COMPUTER PRINT-OUT IDENTIFICATION - LOCAL
CASCADE EXIT PERFORMANCE THROUGH NINTH PAGE

Conical Probe Tangential Position (in)	Y	Exit Mach Number	MS) 2	Exit Axial Mach Number	MS) X, 2	Exit Tangen- tial Mach Number	MS) Y, 2	Exit Total Pressure (psi)	PT) 2	Exit Static Pressure (psi)	P) 2	Total Pres- sure Recovery	PT) 2/PT) 1	Exit Flow Direction (Degrees)	BETA) 2
Conical Probe Tangential Position - z Passage	PERCT	Flow Turning Angle (Degrees)	TURN	Local Exit Mass Flow per inch span (lbs/sec- in.)	M) 2	Total Pres- sure Loss (psi)	DP) 1, 2	Exit Flow Velocity (fps)	V) 2	Nozzle Exit Total Pres- sure - Start of Probe Traverse (psi)	PT) 0	Nozzle Exit Total Pres- sure - End of Probe Traverse (psi)	PT) 0	Nozzle Exit Average Total Pressure (psi)	PT) 0, A
Conical Probe Total Pressure (psi)	PT) TP	Conical Probe Static Pressure Top Port in Vertical Plane (psi)	P) TP	Conical Probe Static Pressure Bottom Port in Vertical Plane (psi)	P) BP	Conical Probe Static Pressure North Port in Horizontal Plane (psi)	P) NP	Conical Probe Static Pres- sure - South Port in Hori- zontal Plane (psi)	P) SP	Flow Direction Referenced to Probe Center- line (Degrees)	BETA) P	Inlet Total Pressure (psi)	PT) 1	Inlet Total Temperature (°R)	TT) 1 288709

TABLE XXII. COMPUTER PRINT-OUT IDENTIFICATION - MASS AVERAGED
AND MIXED EXIT CONDITIONS ON TENTH PAGE

MASS AVERAGED EXIT CONDITIONS

Exit Mach Number	MN) 2
Exit Flow Direction (Degrees)	BETA) 2
Total Pres- sure Recovery	PT) 2/PT) 1

CASCADE EXIT PARAMETERS BASED ON MASS AVERAGED CONDITIONS

Exit Axial Mach Number	MN) X, 2
Exit Tangen- tial Mach Number	MN) Y, 2
Exit Total Pressure (psi)	PT) 2
Exit Static Pressure (psi)	P) 2
Exit Total Temperature (°R)	TT) 2
Exit Total to Static Temperature Ratio	TT) 2/TT) 2
Exit to Inlet Mass Flow Ratio	M) 2/M) 1

MIXED EXIT CONDITIONS

Exit Axial Mach Number	MN) X, 2
Exit Tangen- tial Mach Number	MN) Y, 2
Exit Total Pressure (psi)	PT) 2
Exit Static Pressure (psi)	P) 2
Exit Total Temperature (°R)	TT) 2
Exit Total to Static Temperature Ratio	TT) 2/TT) 2
Exit Mach Number	MN) 2
Exit Flow Direction (Degrees)	BETA) 2

288710

TABLE XXIII. COMPUTER PRINT-OUT IDENTIFICATION -
OVERALL PERFORMANCE ON ELEVENTH PAGE

Static Pressure Ratio P)2/P)1	Total Pressure Recovery PT)2/PT)1	Velocity Ratio V)2/V)1	Axial Velocity Ratio V)2/V)1.X	Tangential Velocity Ratio V)2/V)1.Y	Density Ratio R)2/R)1	Static Temperature Ratio T)2/T)1	Total Pressure Loss Coefficient OMEGA
Total Pressure Loss Parameter TLP	Diffusion Factor DF	Equivalent Diffusion Factor DF)EQ	Ratio of Tangential Velocity Change to Inlet Velocity DV)Y	Exit Reynolds Number RN)2	Static Pressure Rise Parameter DPS/Q1	Deviation Angle (Degrees) DEV	Flow Turning Angle (Degrees) TURN
Exit Flow Direction Calculated from Continuity (Degrees) BETA)C	Flow Area Ratio Calculated from Continuity A)2/A)1						

288711

APPENDIX C

CASCADE DATA

SPLITTER VANE POSITION = 50%

$$P)_2/P)_1 = 1.592$$

$$P)_2/P)_1 = 1.635$$

$$P)_2/P)_1 = 1.686$$

$$P)_2/P)_1 = 1.752$$

$$P)_2/P)_1 = 1.880$$

$$P)_2/P)_1 = 1.949$$

$$P)_2/P)_1 = 2.011$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SUP
ARL STR

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.462	1.664	4	.492

SCANTIVALE
PORT
#

PRESS
SCANTIV
NO.
3

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG. R)
7.856	1.501	57.540	24.281	560.734

9	19.4
11	18.4
13	17.4
15	16.4
17	15.4
19	14.4
21	13.4
23	12.4
25	11.4
27	10.4
29	9.4
31	8.4
33	7.4
35	6.4
37	5.4
39	4.4
41	3.4
43	2.4
45	1.4
47	0.4

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.130	43.060	1.462	1.000	1.257

SPLITTE

STAGGER
ANGLE
(DEG)
39.750

SSOR CASCADE
- 3 TO 1 STAGE

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

GLE = 39.75 DEGREES

PRESSURE DATA FROM SCANIVALVE - PSIA

PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALV NO. 1
4	.400	9	19.649	19.653	19.648	19.603
T SECTION DATA		11	18.556	6.749	6.606	1.701
		13	13.834	9.019	9.766	5.247
		15	11.215	7.965	11.457	4.852
		17	11.157	14.483	10.884	5.080
		19	10.988	10.274	9.578	5.409
TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)	21	19.554	10.020	8.764	6.257
		23	8.923	14.484	8.513	7.173
		25	9.062	13.981	10.328	7.973
		27	9.373	9.158	11.302	7.940
		29	9.327	9.146	9.884	8.763
		31	8.937	14.494	8.828	19.628
		33	9.307	9.250	8.821	2.099
		35	9.032	14.372	8.813	2.407
		37	8.966	9.113	8.810	1.556
		39	9.116	14.479	8.935	1.530
ACROSS LEADING WEDGE		41	9.745	10.005	8.920	1.766
		43	19.602	14.489	9.670	8.801
		45	4.913	10.593	11.775	6.664
		47	19.603	19.617	19.612	5.057

DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.462	1.000	1.057

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.315	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.602	560.734	8.875	65.719

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.462	19.601	560.734	66.880	5.644	.238	8.439
I)SS	I)ML	PN)X,1	PN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.575	1.344	1.427	3.473	1.414

SCANIVALVE
PORT

23
25
27
29
31

MEAN EXIT
STATIC
PRESSURE
(PSIA)
9.120
RMS
DEVIATION
.195

SCANIVALVE
PORT
#

MEAN TRAILING ED

FOR CASCADE
3 TO 1 STAGE

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

IGN PARAMETERS

INLET EXIT TO INLET
RATIO SPAN RATIO
(EXIT) (PROBE MEASURING PLANE)

16 .467

EXIT METAL ANGLE
ML
(DEG.)
22.534

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	8.923	33	9.327
25	9.062	35	9.032
27	9.373	37	8.966
29	9.327	39	9.116
31	8.937	41	9.745

CTIONS

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
9.120	.195	9.233	.280	1.125	1.616

M10 BETA10

8.875 65.719

BLADE TRAILING EDGE PRESSURES

ITIONS

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	8.828
		33	8.821
		35	8.813
		37	8.810
		39	8.935
		41	8.929

P11 M11 Q11

5.644 .238 8.439

TT/T11 PT/P11 NR/12**6

1.427 3.473 1.414

MEAN TRAILING EDGE PRESSURE (PSIA) 8.856 RMS DEVIATION .054

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

ARL

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE = 2.099 PSIA
SOUTH SIDEWALL SLOT PRESSURE = 2.407 PSIA
NORTH BLEED MANIFOLD PRESSURE = 1.556 PSIA
SOUTH BLEED MANIFOLD PRESSURE = 1.530 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE = 548.666 R
SIDEWALL BLEED ORIFICE PRESSURE = 1.766 PSIA
SIDEWALL BLEED ORIFICE DELTA P = .065 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE = .347 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE = .085

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DP
11	6.626	5.247	.1
13	9.766	5.247	.4
15	11.457	4.850	.6
17	10.884	5.080	.6
19	9.578	5.409	.4
21	8.764	6.257	.3
23	8.513	7.173	.3
25	10.328	7.973	.5
27	11.302	7.940	.5
29	9.884	8.763	.5
3	8.873	8.873	.0

FC	FC)X	FC
.362	-.293	.2

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DP
43	9.570	8.801	.1
45	11.775	6.664	.1
47		5.057	

OR CASCADE
3 TO 1 STAGE

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LEED PERFORMANCE

= 2.299 PSIA
= 2.407 PSIA
= 1.556 PSIA
= 1.530 PSIA
= 548.666 R
= 1.766 PSIA
= .065 PSIA
OW RATE = .347 LB/SEC
W RATE = .085

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	6.606	5.247	.114	-.047	.337	.268	13.69	13.45
13	9.766	5.247	.488	-.047	.498	.268	26.98	26.63
15	11.457	4.850	.689	-.094	.585	.247	39.60	39.24
17	10.884	5.080	.621	-.067	.555	.259	49.27	48.78
19	9.578	5.409	.466	-.028	.489	.276	57.88	57.75
21	8.764	6.257	.370	.073	.447	.319	66.00	66.09
23	8.513	7.173	.340	.181	.434	.366	73.41	73.77
25	10.328	7.973	.555	.276	.527	.407	81.70	82.41
27	11.302	7.940	.670	.272	.577	.405	89.05	89.97
29	9.884	8.763	.502	.370	.504	.447	96.93	97.73
3	8.873	8.873	.383	.383	.453	.453	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CF)LE
.362	-.293	.213	-36.014	-.011	.362	.162	44.740

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	9.670	8.801	.477	.374	.493	.449	95.57	93.37
45	11.775	6.664	.727	.121	.601	.340	110.63	102.50
47		5.057		-.070		.258		100.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP
.30	6.284 7.255 18.691	1.146 37.061 10.686	.995 .000 11.338	.570 .853 11.015	18.749 1184.076 11.040	8.284 19.601 -2.661	.957 19.607 19.603	29.789 19.604 560.734	35.24	6.838 -7.417 13.058	.624 51.733 9.750
5.00	6.363 7.849 18.768	1.147 36.467 10.796	.989 .028 11.303	.580 .775 11.075	18.826 1184.188 11.090	8.317 19.607 -2.067	.960 19.636 19.621	30.383 19.622 560.734	40.24	6.917 -4.661 14.035	.775 48.977 9.604
9.99	6.442 8.780 18.911	1.149 35.536 10.894	.981 .028 11.176	.597 .629 11.138	18.973 1186.012 11.120	8.358 19.577 -1.136	.968 19.596 19.586	31.314 19.587 560.390	45.24	6.996 -1.334 16.846	.906 45.650 9.654
14.99	6.521 10.304 18.957	1.163 34.012 10.970	.977 .028 10.873	.631 .565 11.019	19.037 1197.821 10.994	8.232 19.623 .388	.971 19.594 19.608	32.838 19.609 560.390	50.23	7.075 2.770 18.015	1.125 41.546 9.975
19.99	6.600 11.923 18.190	1.146 32.393 10.903	.945 .027 10.427	.648 1.355 10.784	18.246 1183.390 10.675	8.071 19.571 1.997	.931 19.521 19.546	34.457 19.546 560.734	55.23	7.154 5.085 18.294	1.127 39.231 10.365
24.98	6.679 12.842 15.193	.785 31.474 10.677	.640 .024 10.262	.455 4.409 10.309	15.193 859.844 10.240	10.114 19.704 2.926	.775 19.645 19.674	35.376 19.674 560.390	60.23	7.233 6.030 18.421	1.138 38.286 10.468
29.98	6.758 - .978 12.028	.514 45.294 10.035	.478 .018 10.680	.189 7.574 9.817	12.028 581.480 9.778	10.044 19.560 -10.904	.614 19.480 19.519	21.556 19.520 560.734	65.22	7.312 7.516 18.462	1.145 36.800 10.613

ARL 5

LD

97

R CASCADE
TO 1 STAGE

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PERFORMANCE

LOCAL CASCADE EXIT PERFORMANCE

PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 TT)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BET PT)0 TT
18.740	8.284	.957	29.789		6.838	.624	.602	.163	13.058	10.045	.666	15.
84.076	19.601	19.607	19.604	35.24	-7.417	51.733	.017	6.543	697.450	19.603	19.584	19.
11.040	-2.661	19.603	560.734		13.058	9.750	11.283	9.645	9.581	-17.343	19.593	560.
18.826	8.317	.960	30.383		6.917	.775	.738	.238	14.935	10.038	.762	17.
84.188	19.607	19.636	19.622	40.24	-4.661	48.977	.022	4.666	850.304	19.542	19.521	19.
11.090	-2.067	19.621	560.734		14.035	9.604	11.587	9.761	9.826	-14.587	19.531	560.
18.973	8.358	.968	31.314		6.906	.906	.845	.328	15.846	9.896	.859	21.
86.012	19.577	19.596	19.587	45.24	-1.334	45.650	.026	2.755	974.651	19.594	19.583	19.
11.120	-1.136	19.586	560.390		16.846	9.654	11.708	10.248	10.376	-11.250	19.588	560.
19.037	8.232	.971	32.838		7.075	1.125	1.017	.481	18.052	8.100	.921	25.
97.821	19.623	19.594	19.609	50.23	2.770	41.546	.028	1.549	1166.892	19.565	19.553	19.
10.994	.388	19.608	560.390		18.015	9.975	11.636	10.633	10.782	-7.156	19.568	560.
18.246	8.071	.931	34.457		7.154	1.127	.998	.522	18.331	8.306	.935	27.
83.390	19.571	19.521	19.546	55.23	5.085	39.231	.029	1.270	1167.738	19.633	19.588	19.
10.675	1.997	19.546	560.734		18.294	10.365	11.507	10.813	10.899	-4.831	19.610	560.
15.193	10.114	.775	35.376		7.233	1.138	1.000	.544	18.470	8.247	.942	28.
89.844	19.704	19.645	19.674	60.23	6.030	38.286	.028	1.131	1177.307	19.620	19.643	19.
10.240	2.926	19.674	560.390		18.421	10.468	11.399	10.897	10.912	-3.886	19.631	560.
12.028	10.044	.614	21.556		7.312	1.145	.992	.574	18.518	8.192	.945	30.
81.480	19.560	19.480	19.520	65.22	7.516	36.800	.028	1.083	1183.363	19.607	19.581	19.
9.778	-10.904	19.519	560.734		18.462	10.613	11.194	10.872	10.890	-2.410	19.594	560.

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 9.531 18.352	1.152 34.785 10.613	.977 .028 10.708	.612 1.175 10.816	18.426 1188.937 10.710	8.080 19.568 -1.395	.940 19.522 19.545	32.065 19.545 560.734
75.22	7.472 10.150 16.383	.895 34.166 10.412	.754 .026 10.371	.483 3.219 10.377	16.383 964.740 10.221	9.736 19.553 .234	.836 19.557 19.554	32.684 19.555 560.734
80.21	7.549 3.923 14.283	.720 40.393 10.072	.644 .023 10.787	.321 5.318 10.110	14.283 795.363 9.978	10.114 19.626 -6.003	.729 19.575 19.601	26.457 19.601 560.734
85.21	7.628 2.140 16.399	.875 42.176 9.947	.795 .024 11.286	.365 3.202 10.425	16.399 945.973 10.233	9.958 19.578 -7.776	.837 19.534 19.556	24.674 19.556 560.734
90.21	7.707 4.878 18.440	1.149 39.438 10.196	1.020 .027 11.410	.529 1.101 10.867	18.500 1185.879 10.694	8.152 19.586 -5.038	.944 19.580 19.583	27.412 19.583 560.390
95.20	7.786 6.725 18.881	1.154 37.591 10.550	1.007 .029 11.343	.564 .653 11.099	18.948 1190.177 10.958	8.293 19.610 -3.201	.967 19.585 19.597	29.259 19.597 560.734
100.20	7.865 7.939 18.636	1.136 36.378 10.787	.979 .028 11.267	.576 .918 11.173	18.683 1175.830 11.052	8.364 19.657 -1.977	.953 19.641 19.649	30.473 19.649 560.390

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

1.019 28.022 .887

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	M)2/M)1
.900	.479	17.395	8.986	560.734	1.208	1.014

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	MN)2	BETA)2
.791	.474	17.020	9.826	560.734	1.170	.922	30.934

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

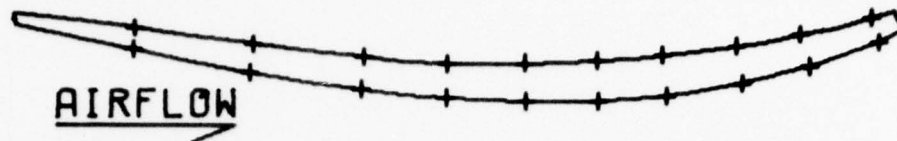
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.592	.887	.758	1.702	.387	1.347	1.182	.158
.037	.390	1.571	.563	1.274	.396	5.488	38.825
34.534	.436						

OVERALL PERFORMANCE

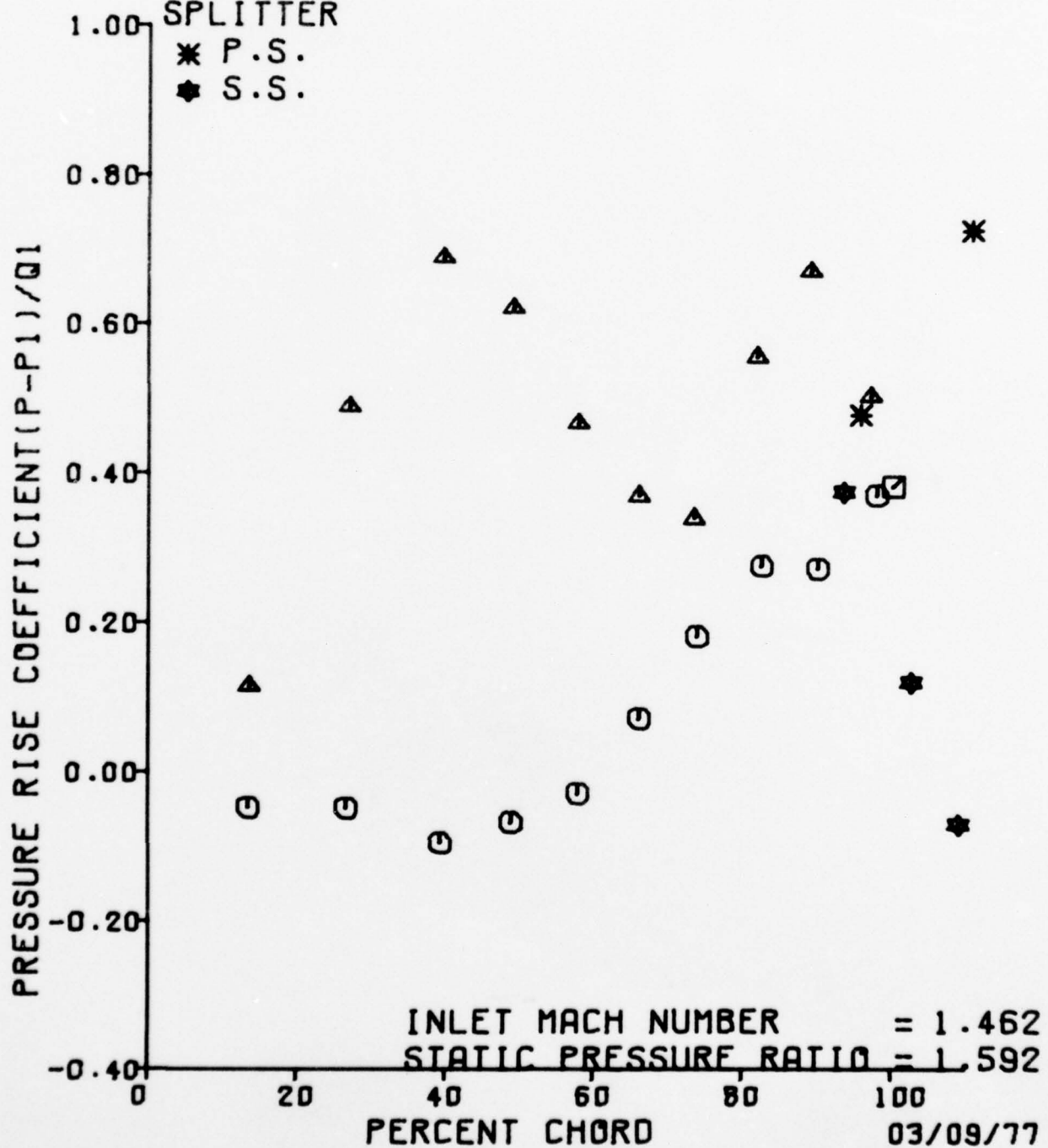
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.741	.868	.697	1.520	.389	1.427	1.220	.185
.042	.451	1.709	.561	1.211	.495	8.400	35.915
32.200	.461						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

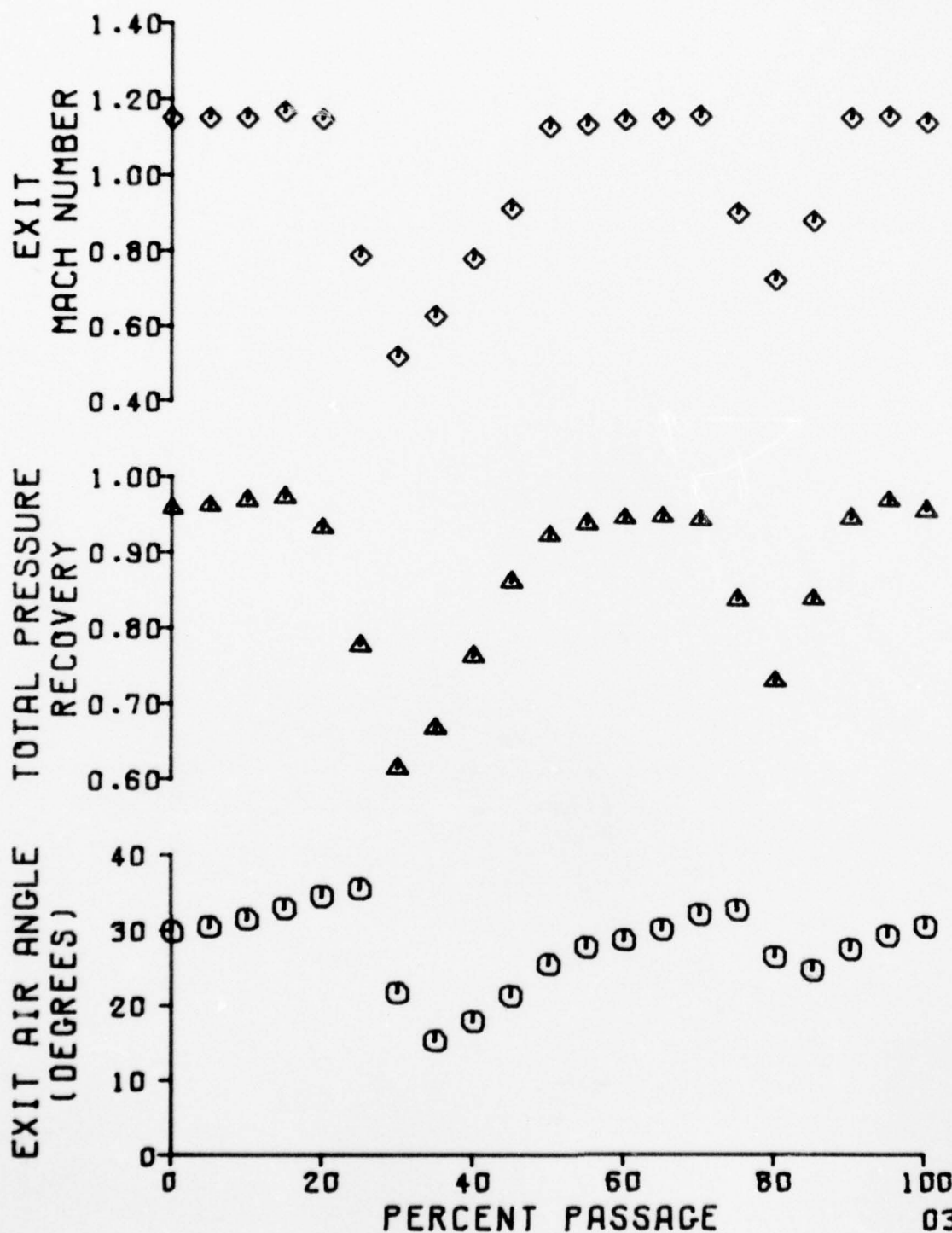


- BLADE
- ▲ P.S.
 - S.S.
 - T.E.
- SPLITTER
- * P.S.
 - ★ S.S.

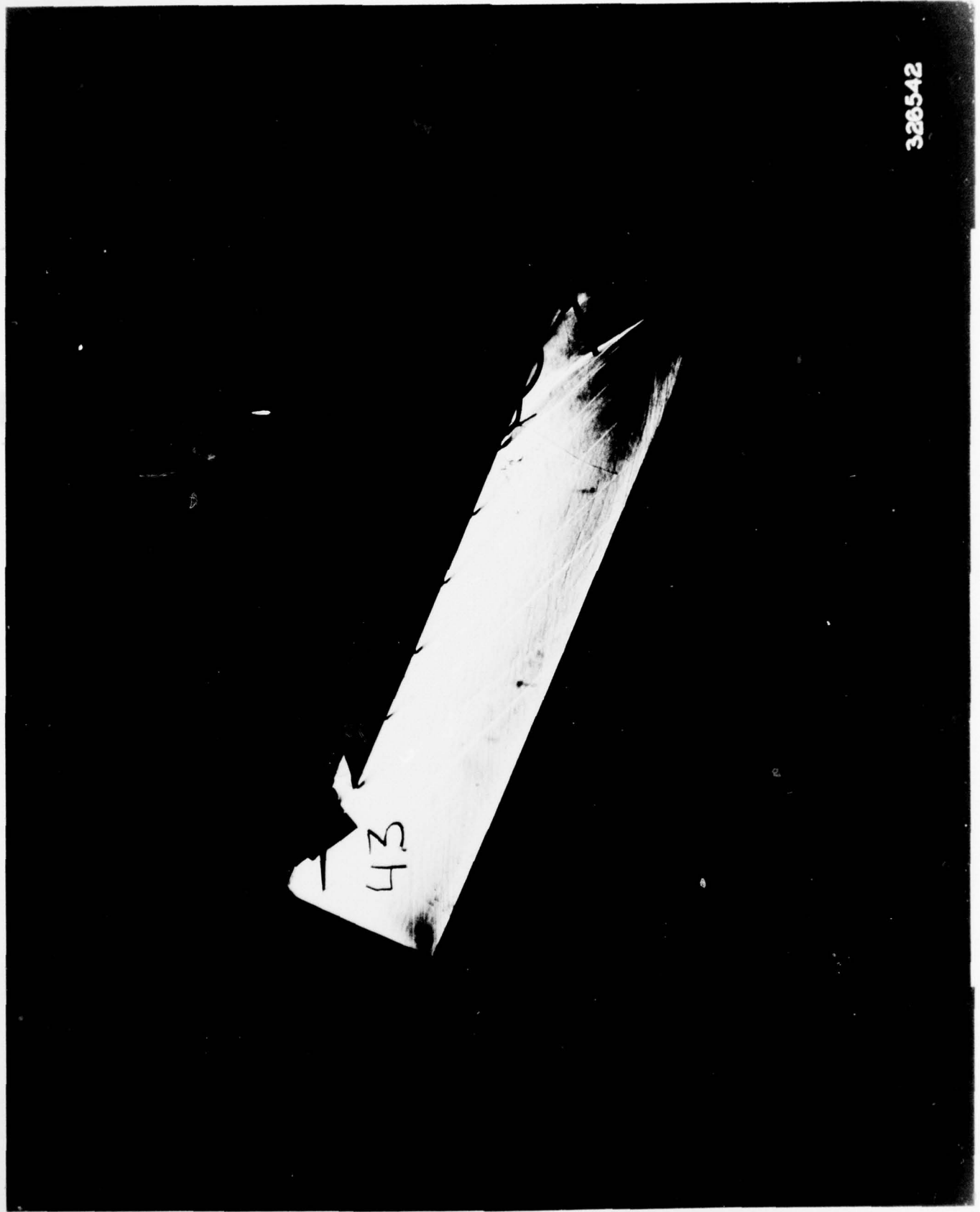


SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
 AXIAL PROBE LOCATION, INCHES, = 0.490
 CASCADE INLET MACH NUMBER = 1.462
 CASCADE STATIC PRESSURE RATIO = 1.592



03/09/77



326542

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.592

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.697	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.856	1.501	57.550	24.279	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.127	43.057	1.462	1.000	1.057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSTA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.439	20.410	20.411	20.419
11	19.236	6.999	7.777	1.711
13	11.347	8.330	10.176	5.447
15	11.814	8.665	12.016	5.247
17	11.697	14.484	11.329	5.422
19	11.565	11.002	9.973	6.094
21	20.390	10.361	9.154	6.886
23	9.596	14.486	9.111	7.829
25	9.698	13.627	11.332	8.597
27	10.029	9.687	11.919	8.760
29	9.974	9.851	10.472	9.443
31	9.658	14.496	9.545	20.407
33	10.005	9.846	9.541	2.136
35	9.682	14.458	9.537	2.486
37	9.670	9.791	9.531	1.582
39	9.802	14.479	9.626	1.558
41	10.364	10.658	9.619	1.773
43	20.445	14.490	10.898	9.194
45	5.160	20.400	12.372	6.981
47	20.487	20.403	20.414	5.320

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

MX)0	PT)0	TT)0	M)0	BETA)0
1.500	20.442	561.079	9.252	65.721

CASCADE INLET CONDITIONS

MX)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.462	20.441	561.079	66.850	5.885	.248	8.801
ISS	I)ML	MX)Y,1	MY)Y,1	TT/T)1	PT/P)1	NR/10**5
1.371	3.402	.575	1.344	1.427	3.473	1.473

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.596	33	10.005
25	9.698	35	9.682
27	10.029	37	9.679
29	9.974	39	9.802
31	9.658	41	10.364

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
9.791	.175	9.906	.258	1.082	1.664

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.545
		33	9.541
		35	9.537
		37	9.531
		39	9.626
		41	9.619

MEAN TRAILING EDGE PRESSURE [PSIA] 9.567 RMS DEVIATION .040

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.136 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.486 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.582 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.558 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.355 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.773 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.062 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.340 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.080

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.777	5.447	.215	-.050	.380	.266	13.69	13.45
13	10.176	5.447	.488	-.050	.498	.266	26.98	26.63
15	12.016	5.247	.697	-.073	.588	.257	39.60	39.24
17	11.329	5.422	.619	-.053	.554	.265	49.07	48.78
19	9.973	6.094	.465	.024	.488	.298	57.88	57.75
21	9.154	6.886	.371	.114	.448	.337	66.00	66.09
23	9.111	7.829	.367	.221	.446	.383	73.41	73.77
25	11.332	8.597	.619	.308	.554	.421	81.70	82.41
27	11.919	8.760	.686	.327	.583	.429	89.05	89.97
29	10.472	9.443	.521	.404	.512	.462	96.93	97.73
0	9.579	9.579	.420	.420	.469	.469	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.367	-.299	.213	-35.457	-.014	.366	.156	42.677

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	10.898	9.194	.570	.376	.533	.450	95.57	93.37
45	12.372	6.981	.737	.125	.605	.342	110.53	102.50
47		5.320		-.064		.260		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 P)10,A T)1
.00	6.284	1.118	.970	.555	19.386	8.881	.948	29.767
	7.233	37.083	.000	1.055	1160.833	20.363	20.391	20.377
	19.353	11.275	11.946	11.622	11.625	-2.683	20.377	560.734
5.00	6.363	1.125	.970	.571	19.486	8.844	.953	30.467
	7.933	36.383	.029	.956	1166.982	20.401	20.377	20.389
	19.447	11.392	11.891	11.644	11.660	-1.983	20.388	560.392
9.00	6.442	1.127	.962	.586	19.560	8.867	.957	31.316
	8.782	35.534	.029	.872	1168.007	20.392	20.349	20.378
	19.529	11.514	11.799	11.700	11.659	-1.124	20.370	560.390
14.00	6.521	1.146	.958	.629	19.652	8.693	.961	33.291
	10.757	33.559	.029	.789	1183.774	20.413	20.416	20.415
	19.592	11.578	11.365	11.630	11.521	.831	20.414	560.734
19.00	6.600	1.098	.898	.631	18.444	8.662	.902	35.072
	12.538	31.778	.028	1.998	1144.177	20.412	20.367	20.390
	18.425	11.503	10.886	11.296	11.180	2.612	20.389	560.390
24.00	6.679	.728	.590	.426	15.239	10.712	.745	35.818
	13.284	31.032	.023	5.202	803.665	20.365	20.320	20.342
	15.239	11.221	10.788	10.789	10.690	3.348	20.342	560.390
29.00	6.758	.493	.456	.189	12.550	10.628	.614	22.485
	7.049	44.365	.018	7.891	559.161	20.380	20.338	20.359
	12.550	10.665	11.236	10.464	10.400	-9.985	20.359	560.390

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

412 D, A 11	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O, A TT)1
757 377 734	35.24	6.838 -6.185 13.446	.589 50.501 10.381	.565 .017 11.725	.166 6.995 10.322	13.446 561.290 10.214	10.633 20.345 -16.111	.658 20.329 20.336	16.349 20.337 560.390
467 389 392	40.24	6.917 -4.155 15.247	.730 46.471 10.243	.693 .021 12.052	.230 5.194 10.445	15.247 805.528 10.443	10.699 20.362 -14.081	.746 20.385 20.373	18.379 20.373 560.390
316 372 392	45.24	6.996 -1.011 17.094	.859 45.327 10.243	.799 .026 12.160	.315 3.347 10.789	17.094 930.649 10.911	10.563 20.316 -10.947	.836 20.303 20.309	21.523 20.309 560.390
291 415 734	50.23	7.075 1.961 18.503	.963 42.355 10.575	.877 .029 12.268	.399 1.939 11.243	18.503 1027.238 11.402	10.196 20.432 -7.965	.905 20.426 20.429	24.495 20.429 560.390
272 392 392	55.23	7.154 4.897 19.053	1.110 39.419 10.909	.985 .030 12.138	.511 1.362 11.434	19.070 1154.047 11.509	8.837 20.421 -5.029	.933 20.380 20.400	27.431 20.400 560.390
818 342 392	60.23	7.233 6.401 19.213	1.111 37.916 11.126	.973 .030 11.996	.538 1.201 11.531	19.241 1155.425 11.564	8.886 20.404 -3.525	.941 20.348 20.376	28.935 20.376 560.390
485 359 392	65.22	7.312 7.975 19.177	1.127 36.341 11.207	.971 .029 11.692	.572 1.224 11.478	19.217 1168.097 11.456	8.707 20.299 -1.951	.940 20.264 20.281	30.509 20.281 560.390

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.02	7.391	1.140	.963	.609	19.203	8.558	.939	32.327
	9.793	34.523	.029	1.239	1178.936	20.466	20.414	20.440
	19.150	11.286	11.320	11.441	11.350	-.133	20.439	560.734
75.02	7.470	.851	.718	.457	16.964	10.566	.830	32.443
	9.909	34.407	.027	3.477	923.520	20.548	20.500	20.524
	16.964	11.174	11.176	11.007	10.867	-.017	20.523	560.390
80.01	7.549	.735	.665	.312	15.486	10.816	.758	25.139
	2.605	41.711	.024	4.956	810.534	20.507	20.496	20.502
	15.486	10.710	11.680	10.846	10.661	-7.331	20.501	560.390
85.01	7.628	.963	.864	.424	18.267	10.070	.694	26.149
	3.615	40.701	.026	2.174	1026.987	20.498	20.442	20.470
	18.267	10.684	12.011	11.293	10.983	-6.311	20.470	560.390
90.01	7.707	1.145	1.009	.540	19.560	8.661	.957	28.143
	5.609	38.707	.030	.881	1183.095	20.452	20.397	20.424
	19.501	10.896	11.995	11.595	11.385	-4.317	20.424	560.045
95.00	7.786	1.140	.987	.570	19.639	8.754	.961	30.232
	7.498	36.818	.030	.802	1178.811	20.470	20.420	20.445
	19.586	11.252	11.872	11.697	11.597	-2.428	20.445	560.390
100.00	7.865	1.109	.950	.572	19.217	8.900	.940	31.019
	8.485	35.831	.029	1.225	1153.574	20.374	20.324	20.349
	19.190	11.382	11.740	11.710	11.567	-1.451	20.349	560.390

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.994 28.334 .884

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 M)2/M)1

.875 .472 18.078 9.622 561.079 1.197 1.005

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 MN)2 BETA)2

.773 .467 17.695 10.424 561.079 1.163 .903 31.161

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

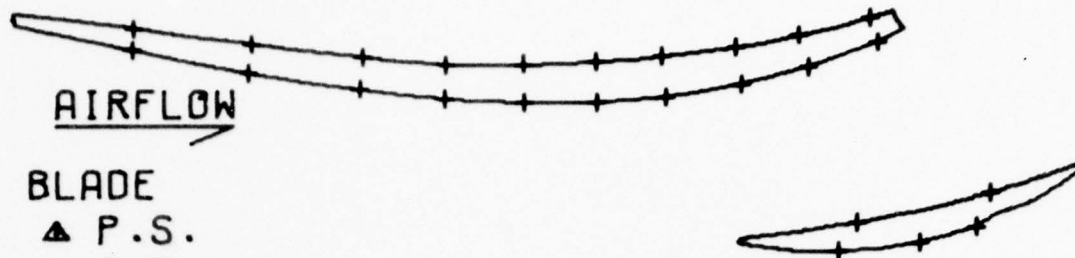
P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.635	.884	.742	1.662	.383	1.372	1.192	.162
.038	.407	1.606	.567	1.315	.425	5.800	36.516
34.269	.439						

OVERALL PERFORMANCE

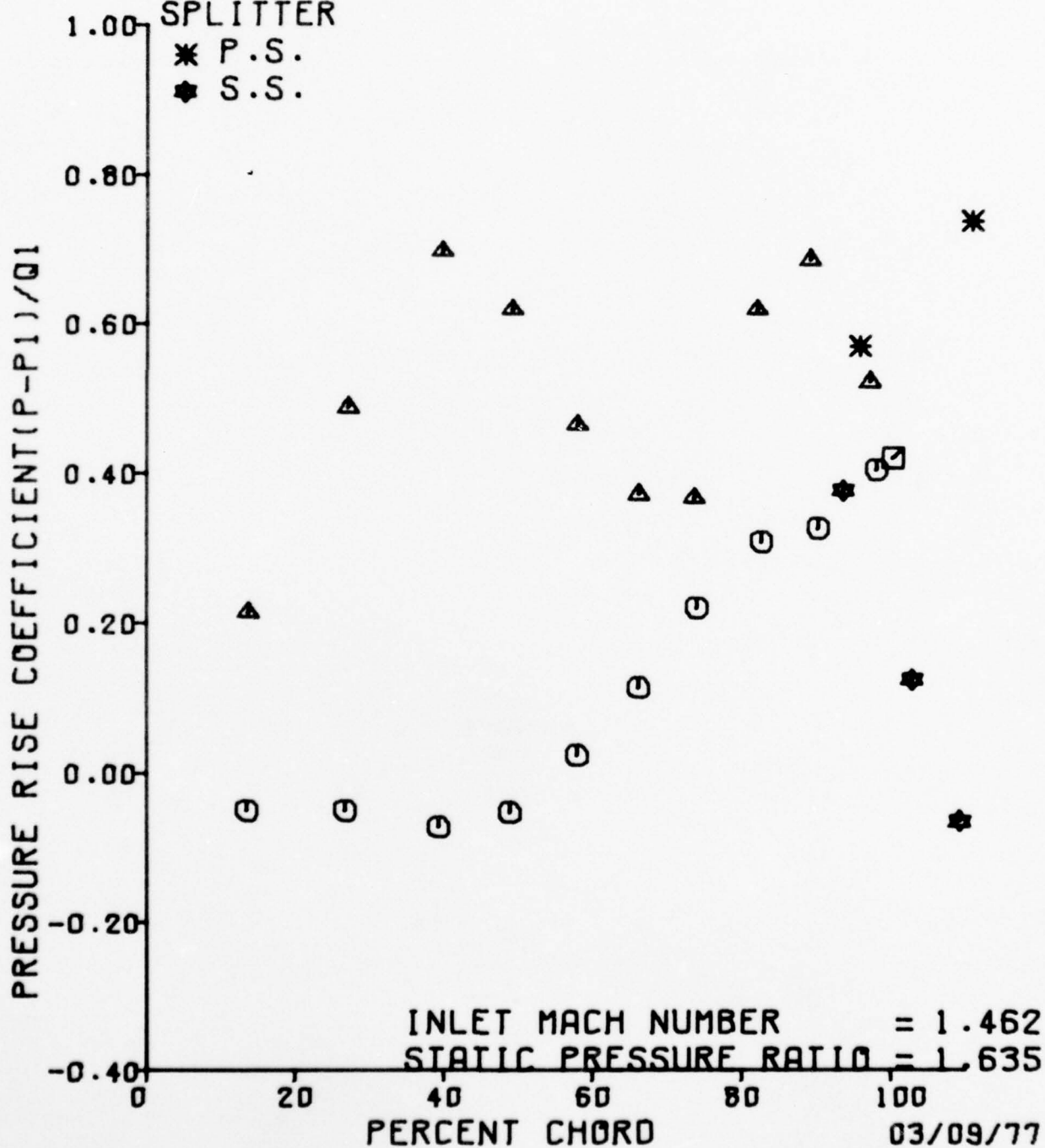
MIXED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.771	.866	.685	1.490	.385	1.444	1.227	.189
.042	.464	1.740	.565	1.249	.516	8.627	35.689
31.656	.465						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

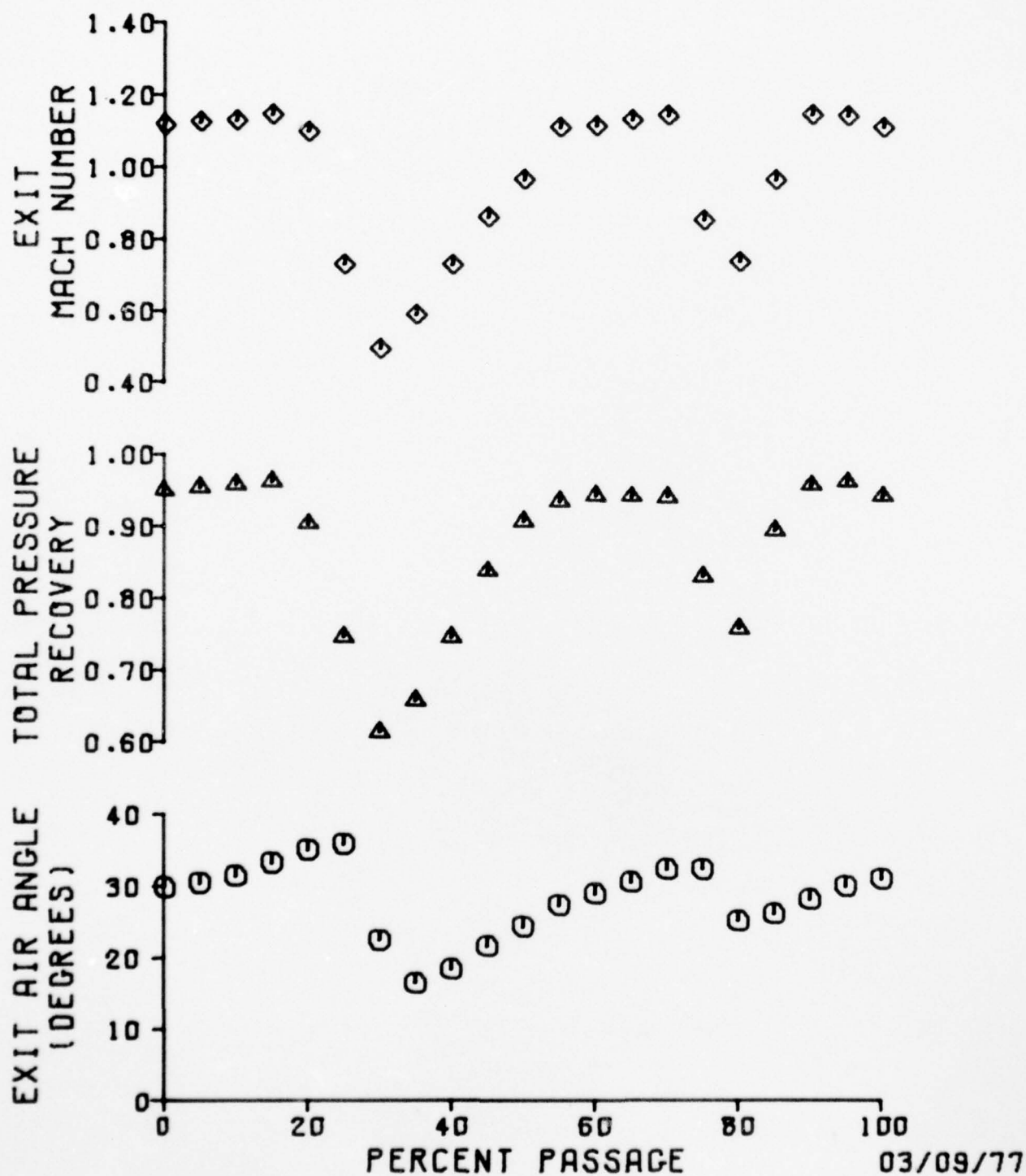


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.

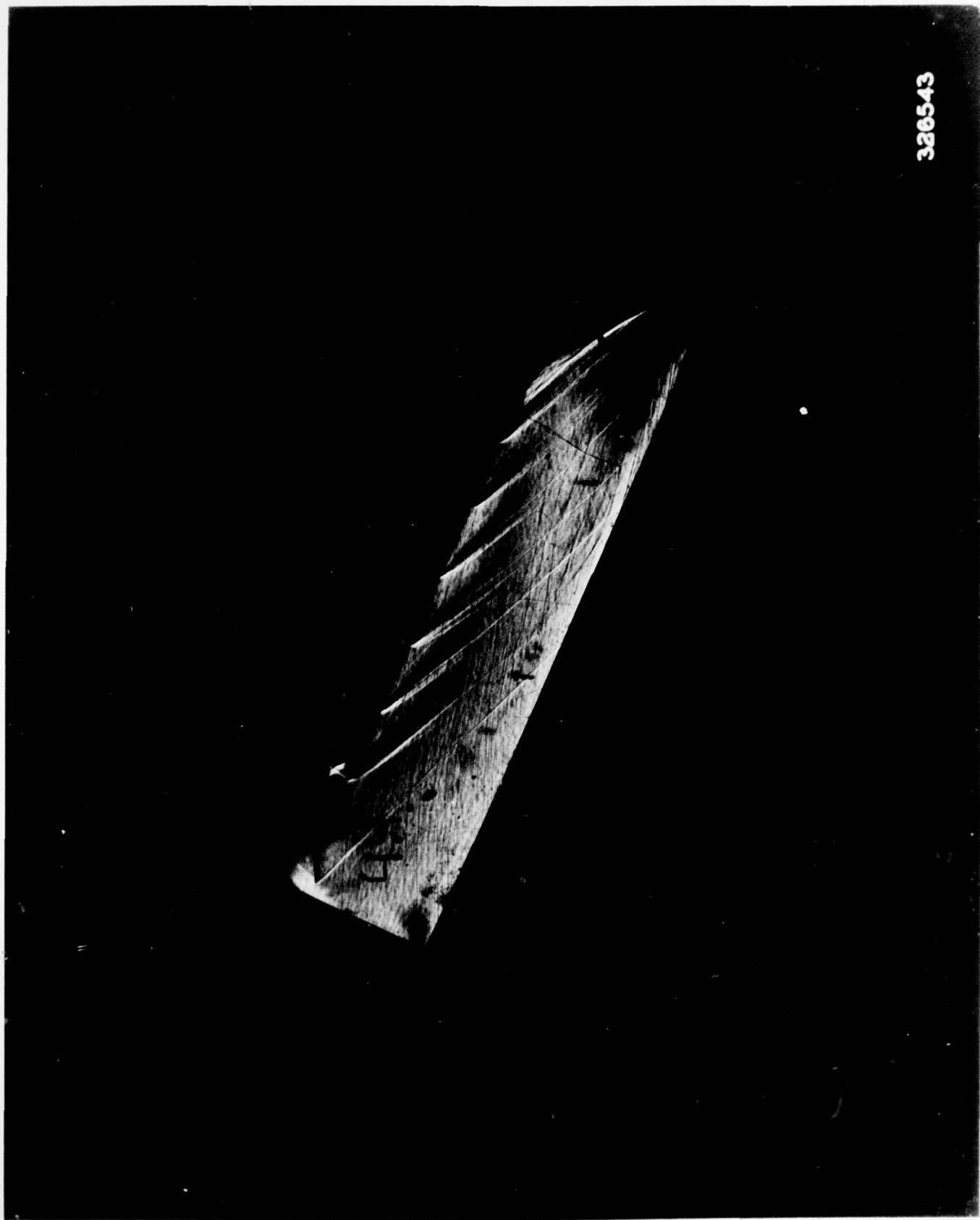


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.462
CASCADE STATIC PRESSURE RATIO = 1.635



03/09/77



326543

CASCADE INLET SCHLIEREN - MN(1) = 1.46, P(2/P)1 = 1.635

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.462	1.736	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.081	1.504	58.010	24.332	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.183	43.120	1.460	1.000	1.260

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

TAL (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	20.542	20.526	20.530	20.525
	11	18.856	6.720	8.407	12.106
	13	10.849	8.564	10.555	5.515
	15	12.443	9.103	12.096	5.386
	17	11.445	14.548	11.179	5.674
	19	11.516	11.516	9.743	6.559
	21	20.468	9.890	9.073	7.379
	23	9.927	14.549	9.694	8.335
	25	9.961	11.340	11.695	8.913
	27	10.296	10.274	12.156	9.141
	29	10.202	10.269	10.732	9.803
	31	9.852	14.562	9.924	20.532
	33	10.201	10.135	9.916	2.080
	35	9.980	10.230	9.910	2.340
	37	9.980	10.013	9.903	1.589
	39	10.010	14.545	9.968	1.522
	41	10.542	10.920	9.959	1.769
	43	20.485	14.550	11.577	8.974
	45	5.146	20.502	12.560	6.845
	47	20.504	20.509	20.518	5.236

TIC
SURE
TIO

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

2

SUPersonic COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

NO	PT	TT	M	BETA
1.500	20.505	561.079	9.281	65.668

CASCADE INLET CONDITIONS

NO	PT	TT	BETA	P	M	Q
1.460	20.504	561.079	66.860	5.919	.249	8.829
I)SS	I)ML	NO)X,1	NO)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.478

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

(LANE)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3	MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
23	9.927	33	10.201	12.048	.171	10.143	.216	1.063	1.697
25	9.961	35	9.980						
27	10.296	37	9.980						
29	10.202	39	10.010						
31	9.852	41	10.542						

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.924
		33	9.916
		35	9.910
		37	9.903
		39	9.968
		41	9.959

MEAN TRAILING EDGE PRESSURE [PSIA] 9.930 RMS DEVIATION .025

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.080 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.340 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.589 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.522 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.390 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.769 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.048 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.301 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.070

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.407	5.515	.282	-.046	.410	.269	13.69	13.45
13	10.555	5.515	.525	-.046	.515	.269	26.98	26.63
15	12.096	5.386	.700	-.060	.590	.263	39.60	39.24
17	11.179	5.674	.596	-.028	.545	.277	49.07	48.78
19	9.743	6.559	.433	.072	.475	.320	57.88	57.75
21	9.073	7.379	.357	.165	.442	.360	66.00	66.09
23	9.694	8.335	.428	.274	.473	.407	73.41	73.77
25	11.605	8.913	.654	.339	.570	.435	81.72	82.41
27	12.156	9.141	.706	.365	.593	.446	89.05	89.97
29	10.732	9.803	.545	.440	.523	.478	96.93	97.73
0	9.935	9.935	.455	.455	.485	.485	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.364	-.298	.209	-35.236	-.017	.364	.149	40.808

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.577	8.974	.641	.346	.565	.438	95.57	93.37
45	12.560	6.845	.752	.105	.613	.334	110.63	102.50
47		5.236		-.077		.255		109.00

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

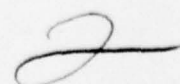
LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.20	6.284	1.098	.977	.501	19.260	9.045	.939	27.139
	4.625	39.711	.000	1.244	1144.171	20.519	20.486	20.503
	19.240	11.375	12.269	11.730	11.573	-4.851	20.502	561.424
5.00	6.363	1.098	.970	.515	19.372	9.092	.945	27.934
	5.420	38.916	.030	1.132	1144.638	20.512	20.462	20.487
	19.352	11.242	12.245	11.815	11.617	-4.066	20.486	561.079
9.99	6.442	1.103	.964	.537	19.407	9.053	.946	29.119
	6.585	37.731	.030	1.097	1148.717	20.526	20.488	20.507
	19.384	11.391	12.105	11.869	11.612	-2.881	20.507	561.079
14.99	6.521	1.127	.970	.574	19.526	8.847	.952	30.612
	8.078	36.238	.030	.979	1168.097	20.534	20.480	20.507
	19.485	11.453	11.803	11.847	11.524	-1.388	20.507	561.079
19.99	6.600	1.133	.956	.608	19.222	8.642	.937	32.468
	9.934	34.382	.029	1.282	1173.256	20.532	20.485	20.509
	19.177	11.428	11.328	11.658	11.287	.478	20.509	560.734
24.98	6.679	.795	.675	.420	16.380	10.798	.799	31.902
	9.368	34.048	.026	4.124	869.813	20.509	20.490	20.500
	16.380	11.176	11.190	11.142	10.902	-0.088	20.490	561.079
29.98	6.758	.710	.633	.321	15.237	10.890	.743	26.882
	4.346	39.970	.023	5.268	785.351	20.524	20.496	20.510
	15.237	10.857	11.493	10.910	10.885	-5.110	20.510	560.734

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

A)2 O, A 11	PERCT	Y DEV PT)Y P	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O, A TT)1
139 503 424	35.24	6.838 2.656 16.949	.820 41.560 10.789	.742 .025 11.915	.349 3.555 11.150	16.949 894.267 11.217	12.804 20.518 -6.800	.627 20.473 20.495	25.190 20.405 560.734
934 487 079	40.24	6.917 4.916 18.962	1.085 39.400 11.024	.963 .028 12.112	.500 1.529 11.519	18.975 1133.395 11.577	9.053 20.506 -4.540	.925 20.489 20.497	27.450 20.408 560.734
119 507 079	45.24	6.996 6.348 19.659	1.127 37.968 11.332	.986 .030 12.123	.544 .804 11.742	19.700 1168.097 11.783	8.926 20.523 -3.108	.961 20.496 20.509	28.882 20.509 561.079
612 507 079	50.23	7.075 7.589 19.794	1.127 36.727 11.584	.974 .030 12.063	.565 .660 11.879	19.835 1168.097 11.847	8.988 20.529 -1.867	.967 20.492 20.510	30.123 20.510 560.734
468 509 734	55.23	7.154 8.783 19.758	1.123 35.533 11.742	.959 .030 11.914	.584 .708 11.896	19.796 1165.016 11.830	9.012 20.538 -.673	.965 20.482 20.510	31.317 20.510 561.079
902 500 079	60.23	7.233 9.831 19.411	1.108 34.485 11.749	.936 .029 11.658	.593 1.068 11.839	19.437 1152.603 11.720	9.015 20.571 .365	.948 20.516 20.543	32.365 20.544 561.079
882 510 734	65.02	7.312 11.180 18.501	.925 33.136 11.665	.770 .028 11.309	.514 2.004 11.633	18.501 992.812 11.447	10.638 20.523 1.724	.902 20.493 20.508	33.714 20.508 561.079



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 11.716 16.928	.820 32.600 11.468	.676 .026 11.092	.462 3.577 11.317	16.928 894.267 11.110	10.880 20.530 2.260	.826 20.475 20.502	34.250 20.502 561.079
75.22	7.470 8.428 13.949	.603 35.908 11.123	.517 .021 11.218	.310 6.555 10.908	13.949 575.859 10.779	10.911 20.524 -1.048	.680 20.484 20.504	30.942 20.504 560.734
80.21	7.549 -5.945 13.029	.510 50.261 10.798	.488 .017 11.773	.146 7.475 10.661	13.029 576.949 10.579	10.913 20.534 -15.411	.635 20.495 20.515	16.589 20.515 560.734
85.21	7.626 -5.727 14.545	.651 50.043 10.620	.623 .019 12.221	.188 5.959 10.594	14.545 726.043 10.501	10.938 20.555 -15.183	.709 20.500 20.527	16.807 20.527 561.079
90.21	7.707 -3.685 16.323	.778 48.001 10.487	.736 .024 12.455	.251 4.201 10.797	16.303 853.194 10.746	10.928 20.519 -13.141	.795 20.486 20.502	18.849 20.502 561.079
95.20	7.786 -3.808 17.850	.876 45.124 10.594	.813 .028 12.519	.324 2.654 11.187	17.850 946.566 11.193	10.835 20.526 -10.274	.871 20.477 20.501	21.726 20.501 560.734
100.20	7.865 2.605 18.869	1.053 41.711 10.855	.953 .030 12.454	.447 1.632 11.461	18.873 1106.107 11.512	9.362 20.523 -6.851	.920 20.469 20.495	25.139 20.495 560.734

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MA12 BETA12 PT12/PT11

.958 27.949 .878

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MA1X,2 MA1Y,2 PT12 P12 TT12 TT12/TT12 M12/M11

.847 .449 18.010 9.980 561.079 1.184 .999

MIXED EXIT CONDITIONS

MA1X,2 MA1Y,2 PT12 P12 TT12 TT12/TT12 MA12 BETA12

.753 .445 17.648 10.715 561.079 1.153 .875 30.583

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

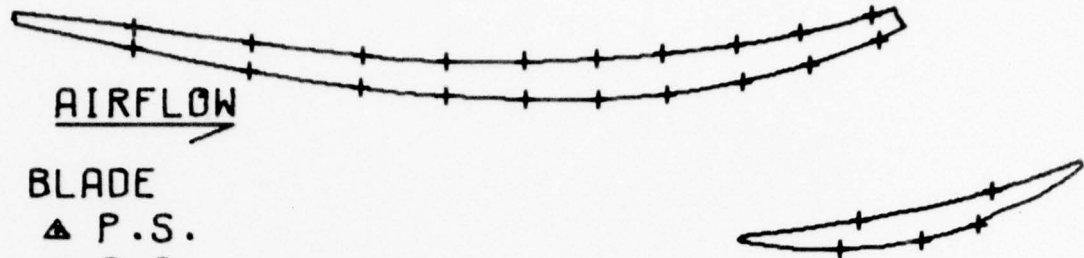
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/D1	DEV	TURN
BETA)C	A)2/A)1						
1.686	.878	.721	1.619	.367	1.399	1.205	.171
.040	.432	1.656	.582	1.296	.460	5.415	36.901
33.475	.441						

OVERALL PERFORMANCE

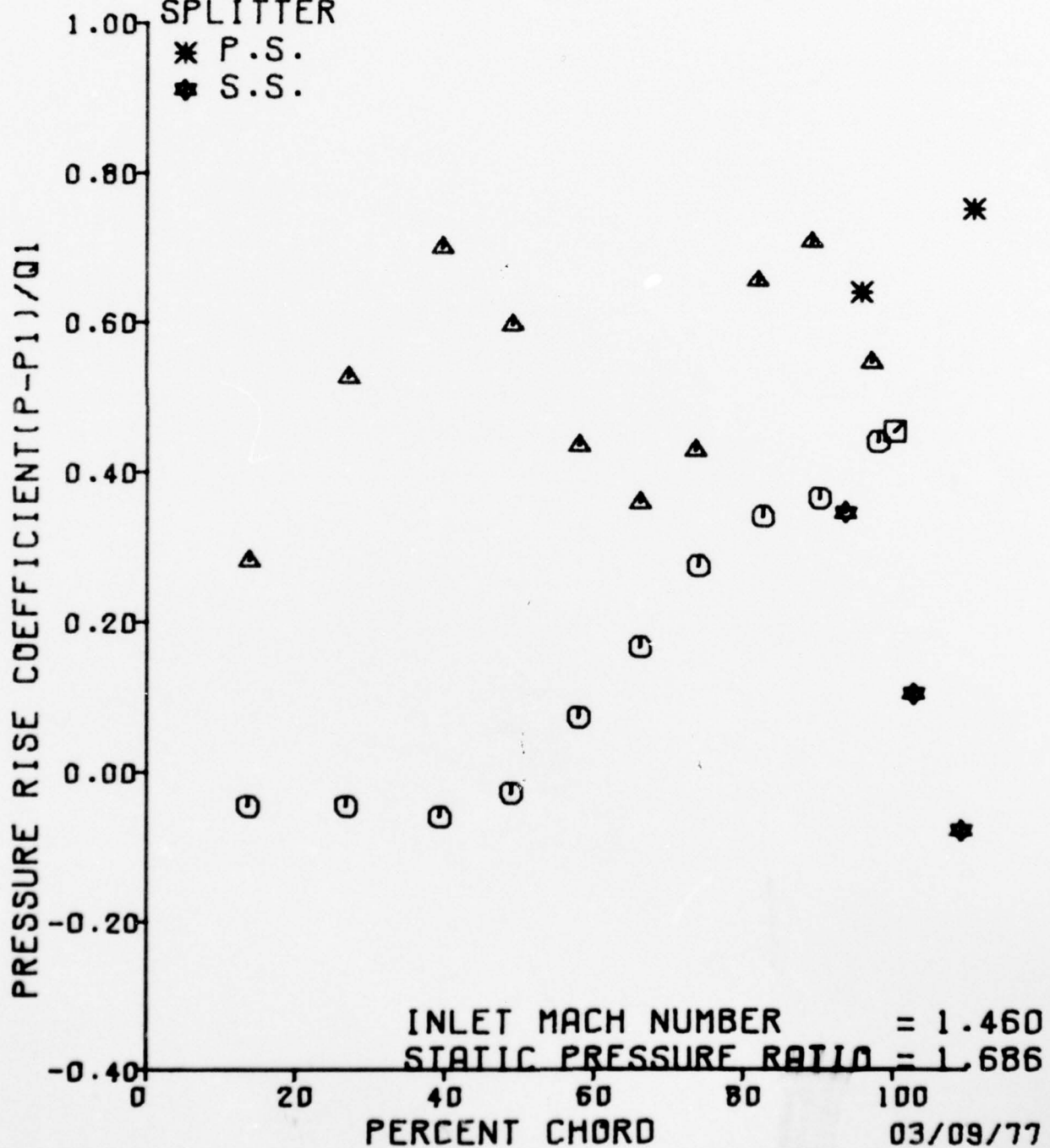
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/D1	DEV	TURN
BETA)C	A)2/A)1						
1.810	.861	.667	1.460	.369	1.464	1.237	.195
.044	.486	1.790	.580	1.230	.543	8.049	36.267
30.465	.468						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

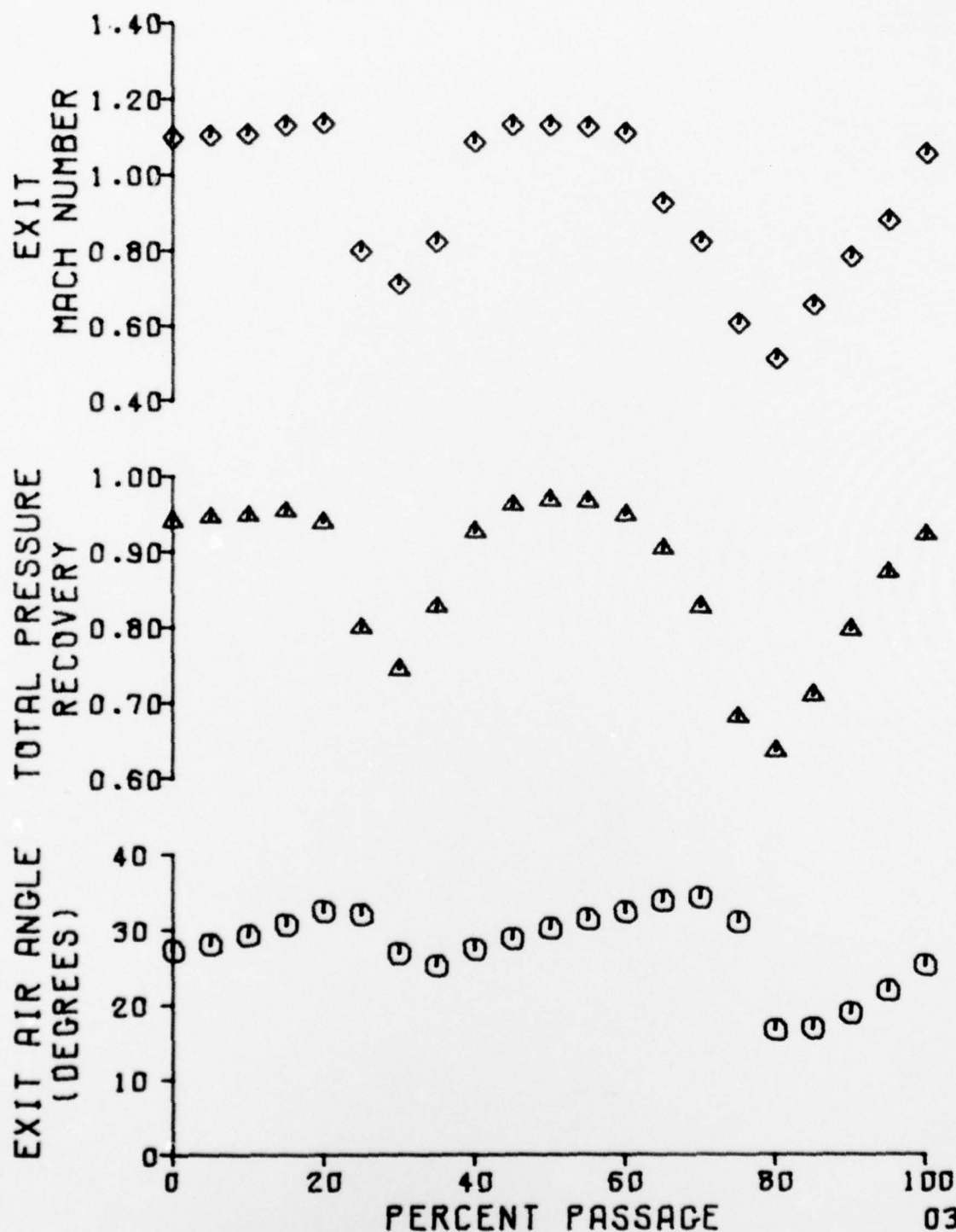


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.686



03/09/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.775	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.501	57.550	24.276	560.045

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.126	43.055	1.462	1.000	1.057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.570	20.586	20.584	20.589
11	19.154	7.051	9.321	1.448
13	11.642	8.738	10.497	5.486
15	12.038	9.799	12.232	5.655
17	11.945	14.497	11.417	5.986
19	11.819	11.440	10.066	6.849
21	20.541	10.450	9.331	7.777
23	10.100	14.498	10.110	8.652
25	10.196	13.270	11.965	9.143
27	10.487	10.020	12.303	9.500
29	10.434	10.464	10.968	10.076
31	10.185	14.508	10.219	20.594
33	10.489	10.551	10.208	2.084
35	10.171	14.473	10.207	2.540
37	10.181	10.347	10.194	1.594
39	10.316	14.493	10.253	1.577
41	10.831	11.128	10.248	1.471
43	20.541	14.502	11.910	9.293
45	5.180	20.577	12.675	7.069
47	20.602	20.580	20.584	6.055

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.520	20.571	560.045	9.320	65.724

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.462	20.571	560.045	66.850	5.922	.250	8.856
I)SS	I)ML	PN)X,1	PN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.575	1.344	1.427	3.474	1.486

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.100	33	10.489
25	10.196	35	10.171
27	10.487	37	10.181
29	10.434	39	10.316
31	10.185	41	10.831

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.280	.152	10.398	.245	1.047	1.736

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.219
		33	10.208
		35	10.207
		37	10.194
		39	10.253
		41	10.248

MEAN TRAILING EDGE PRESSURE (PSIA) 10.222 RMS DEVIATION .022

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.084 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.540 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.594 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.577 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.355 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.471 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.023 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.195 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.046

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.321	5.486	.384	-.049	.453	.267	13.69	13.45
13	10.497	5.486	.517	-.049	.510	.267	26.98	26.63
15	12.232	5.655	.713	-.030	.595	.275	39.60	39.24
17	11.417	5.986	.621	.007	.555	.291	49.07	48.78
19	10.066	6.849	.468	.105	.489	.333	57.88	57.75
21	9.331	7.777	.385	.209	.454	.378	66.40	66.09
23	10.110	8.652	.473	.308	.491	.421	73.41	73.77
25	11.965	9.143	.682	.364	.582	.444	81.70	82.41
27	12.303	9.500	.721	.404	.598	.462	89.05	89.97
29	10.968	10.076	.570	.469	.533	.490	96.93	97.73
0	10.223	10.223	.486	.486	.497	.497	100.00	100.00
	FC	FC)X	FC)Y	BETA)F	CD11	CL11	MC1LE	CP1LE
	.375	-.329	.213	-34.626	-.020	.375	.148	39.303

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.910	9.293	.676	.381	.579	.452	95.57	93.37
45	12.675	7.069	.762	.130	.616	.344	110.63	102.50
47		6.055		.015		.294		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1	PE
.20	6.284 7.434 19.488	1.289 36.882 11.569	.943 .000 12.186	.544 1.068 11.884	19.503 1135.610 11.885	9.261 20.452 -2.492	.948 20.426 20.439	29.968 20.439 559.700	35
5.20	6.363 7.915 19.532	1.085 36.401 11.653	.936 .030 12.151	.550 1.026 11.936	19.545 1132.525 11.926	9.323 20.441 -2.011	.950 20.439 20.440	30.449 20.444 559.700	40
9.99	6.442 8.964 19.647	1.098 35.352 11.818	.937 .030 12.059	.574 .904 12.023	19.667 1143.623 11.951	9.229 20.552 -.962	.956 20.544 20.548	31.408 20.548 560.045	45
14.99	6.521 10.207 19.555	1.108 34.109 11.817	.932 .029 11.746	.599 .989 11.934	19.581 1151.455 11.820	9.083 20.562 .281	.952 20.530 20.546	32.741 20.546 560.045	50
19.99	6.600 11.920 18.373	.895 32.396 11.752	.738 .028 11.356	.507 2.198 11.678	18.373 964.146 11.597	10.918 20.536 1.994	.893 20.500 20.517	34.454 20.518 559.700	55
24.98	6.679 12.232 15.879	.729 32.084 11.543	.599 .024 11.232	.416 4.692 11.299	15.879 803.997 11.216	11.150 20.544 2.306	.772 20.506 20.525	34.766 20.525 559.700	60
29.98	6.758 4.441 13.096	.496 39.875 11.187	.442 .018 11.518	.225 7.475 10.978	13.096 561.404 10.914	11.071 20.540 -5.485	.637 20.508 20.524	26.975 20.524 559.700	65

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 JO, A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MA)Y,2 DF)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O, A T)1
.968 .439 .700	35.24	6.838 -5.056 13.353	.527 49.372 10.890	.502 .017 11.916	.158 7.218 10.792	13.353 594.598 10.708	11.054 20.518 -14.982	.649 20.486 20.502	17.478 20.502 559.700
.449 .449 .700	40.24	6.017 -4.300 14.747	.652 48.616 10.728	.619 .020 12.242	.204 5.823 10.818	14.747 725.620 10.785	11.088 20.517 -14.226	.717 20.463 20.490	18.034 20.490 559.700
.408 .548 .045	45.24	6.996 -1.938 16.434	.767 46.254 10.683	.718 .024 12.437	.270 4.137 11.009	16.434 841.908 11.149	11.131 20.523 -11.864	.799 20.467 20.495	20.595 20.495 559.700
.741 .545 .045	50.23	7.075 .738 17.891	.859 43.578 10.819	.789 .027 12.505	.339 2.680 11.335	17.891 930.067 11.566	11.052 20.529 -9.188	.870 20.504 20.516	23.272 20.517 559.355
.454 .518 .700	55.23	7.154 3.174 18.857	.915 41.142 11.116	.825 .029 12.513	.397 1.713 11.636	18.857 982.518 11.808	10.966 20.570 -6.752	.917 20.543 20.556	25.708 20.557 559.700
.766 .525 .700	60.23	7.233 5.671 19.220	1.053 38.645 11.336	.928 .030 12.347	.498 1.348 11.705	19.223 1105.087 11.817	9.536 20.545 -4.255	.934 20.500 20.523	28.205 20.523 559.355
.975 .524 .700	65.22	7.312 7.124 19.212	1.053 37.192 11.460	.915 .030 12.127	.521 1.355 11.757	19.215 1105.087 11.827	9.532 20.534 -2.802	.934 20.487 20.511	29.658 20.511 559.700

PCO PROBE

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
70.02	7.391 8.954 19.008	1.053 35.362 11.482	.898 .029 11.711	.550 1.559 11.656	19.012 1105.087 11.661	9.431 20.558 -1.972	.924 20.476 20.517	31.488 20.517 559.355
75.02	7.470 8.424 17.021	.820 35.892 11.312	.704 .027 11.562	.422 3.550 11.287	17.021 893.443 11.236	10.940 20.481 -1.502	.827 20.438 20.459	30.958 20.459 559.355
80.01	7.549 2.053 15.768	.722 41.363 11.021	.652 .024 11.941	.311 4.802 11.146	15.768 797.353 11.003	11.140 20.493 -6.973	.767 20.458 20.475	25.487 20.475 559.355
85.01	7.628 3.098 17.898	.868 41.218 10.970	.783 .026 12.242	.376 2.672 11.515	17.898 938.918 11.221	10.948 20.534 -6.828	.870 20.488 20.511	25.632 20.511 559.355
90.01	7.707 5.479 19.376	1.106 38.837 11.186	.977 .029 12.295	.520 1.170 11.773	19.401 1150.141 11.609	9.017 20.525 -4.467	.943 20.476 20.500	28.013 20.500 559.700
95.00	7.786 7.006 19.407	1.087 37.310 11.432	.946 .030 12.158	.536 1.150 11.867	19.421 1134.260 11.763	9.240 20.461 -2.950	.944 20.421 20.441	29.540 20.441 559.700
100.00	7.865 8.130 19.009	.929 36.186 11.590	.799 .029 11.989	.474 1.472 11.904	19.009 995.313 11.781	10.937 20.478 -1.826	.928 20.419 20.448	30.664 20.448 559.355

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.924 28.072 .875

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.815	.435	18.006	10.372	560.045	1.171	.993

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12	BETA12
.735	.432	17.662	10.980	560.045	1.145	.853	30.447

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

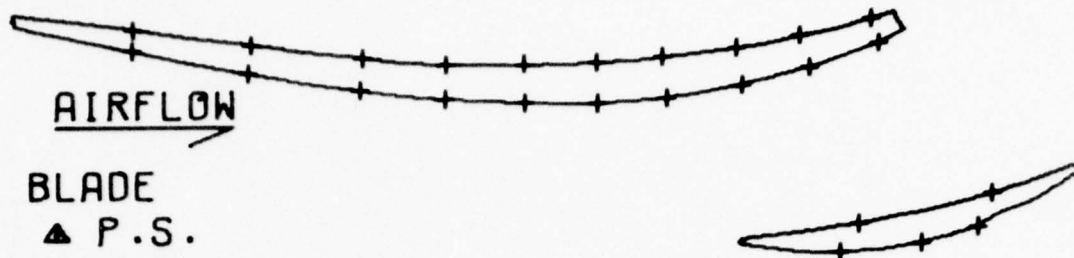
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.752	.875	.698	1.566	.357	1.437	1.219	.175
.041	.456	1.712	.591	1.284	.503	5.538	38.778
32.950	.444						

OVERALL PERFORMANCE

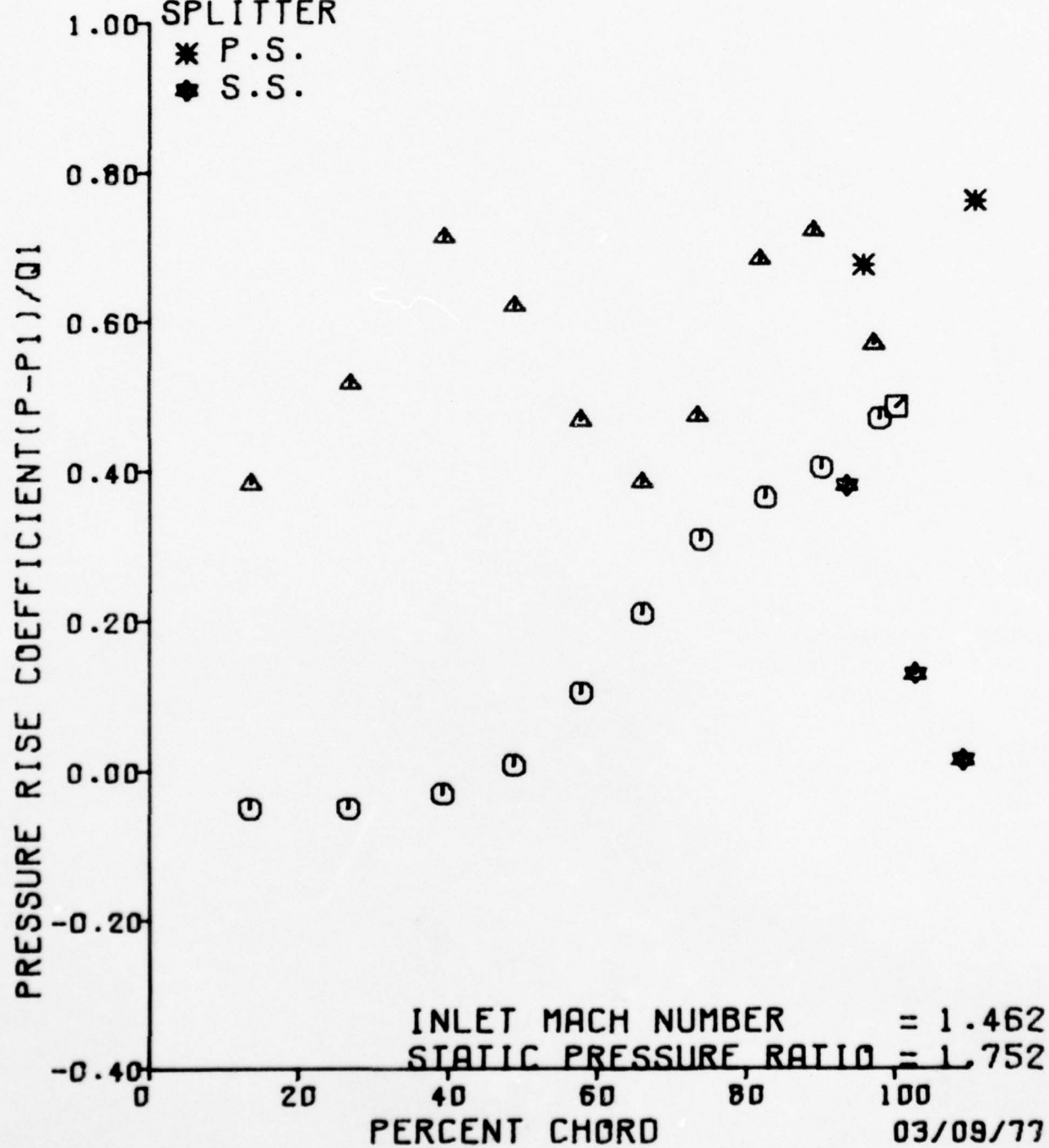
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.854	.859	.651	1.428	.359	1.488	1.246	.199
.045	.504	1.834	.589	1.221	.571	7.913	36.403
29.767	.471						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

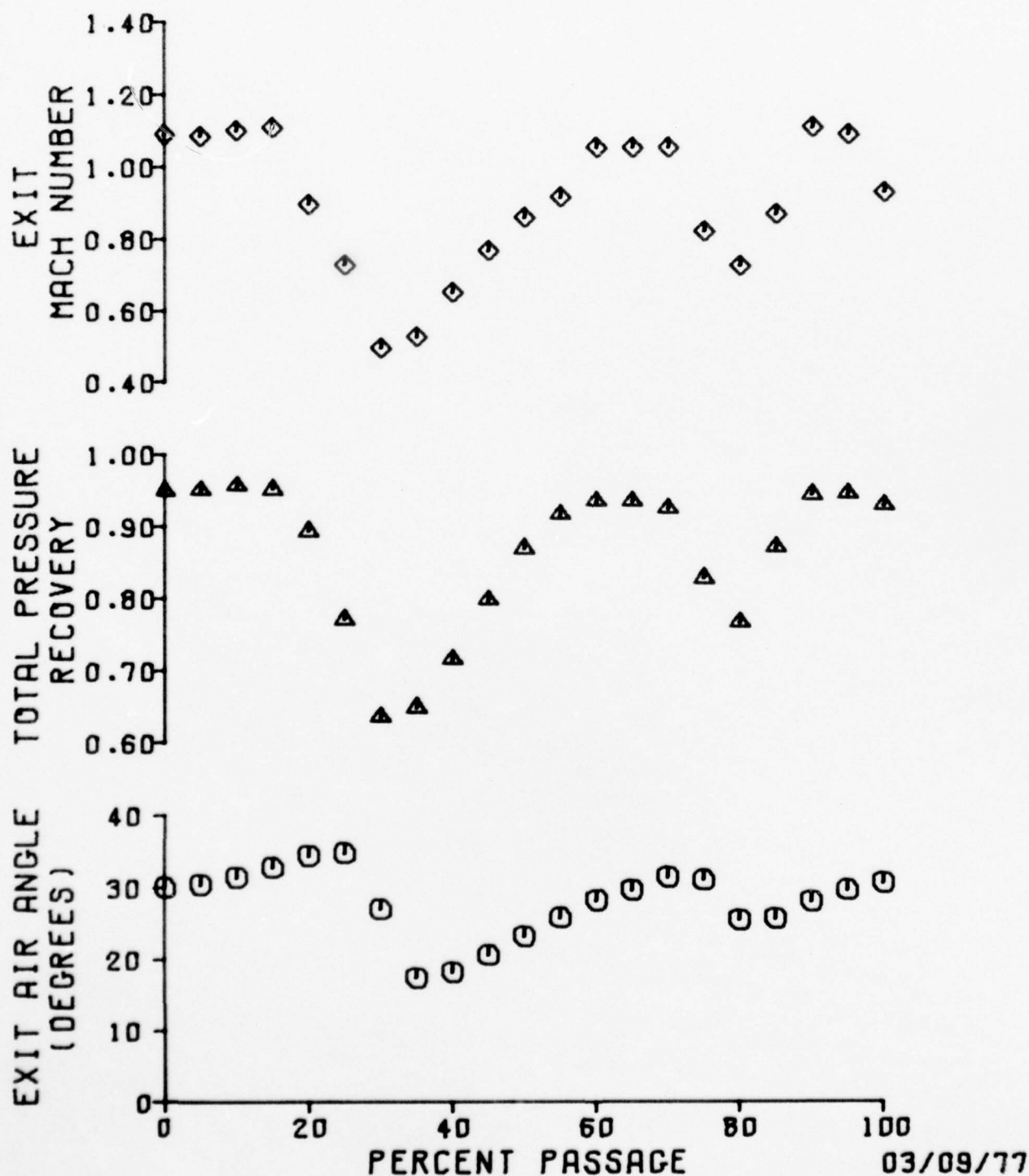


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.462
CASCADE STATIC PRESSURE RATIO = 1.752





326544

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.752

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.817	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.068	1.504	58.010	24.333	561.424

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.182	43.119	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.517	20.508	20.504	20.500
11	18.335	6.720	9.665	12.337
13	11.079	9.017	10.937	5.544
15	12.551	10.114	12.295	5.687
17	11.603	14.549	11.113	6.324
19	11.700	11.732	9.608	6.606
21	20.483	9.739	9.231	8.180
23	10.428	14.551	10.811	9.046
25	10.429	11.609	12.160	9.359
27	10.712	10.794	12.470	9.802
29	10.599	10.803	11.160	10.400
31	10.365	14.562	10.510	20.528
33	10.695	10.767	10.500	2.085
35	10.471	10.724	10.494	2.350
37	10.486	10.529	10.494	1.600
39	10.515	14.546	10.560	1.540
41	10.955	11.328	10.554	1.765
43	20.489	14.552	12.255	8.974
45	5.146	20.509	12.828	6.836
47	20.518	20.535	20.538	6.588

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	20.506	561.424	9.279	65.667

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	20.506	561.424	66.850	5.919	.249	8.829
I)SS	I)ML	MN)Y,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.477

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.428	33	10.695
25	10.429	35	10.471
27	10.712	37	10.486
29	10.599	39	10.515
31	10.365	41	10.955

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.507	.129	10.624	.184	1.026	1.775

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.510
		33	10.500
		35	10.494
		37	10.494
		39	10.560
		41	10.554

MEAN TRAILING EDGE PRESSURE [PSIA] 10.519 RMS DEVIATION .028

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.085 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.350 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.600 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.540 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.700 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.765 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.052 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.313 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

SUPersonic COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.665	5.544	.424	-.042	.471	.270	13.69	13.45
13	10.937	5.544	.568	-.042	.533	.270	26.98	26.63
15	12.295	5.687	.699	-.026	.590	.277	39.60	39.24
17	11.113	6.324	.588	.046	.542	.308	49.07	48.78
19	9.698	6.606	.428	.078	.473	.322	57.88	57.75
21	9.231	8.180	.375	.256	.450	.399	66.00	66.09
23	10.811	9.046	.554	.354	.527	.441	73.41	73.77
25	12.160	9.359	.707	.390	.593	.456	81.70	82.41
27	12.470	9.802	.742	.440	.608	.478	89.05	89.97
29	11.160	10.400	.594	.507	.544	.507	96.93	97.73
0	10.527	10.527	.522	.522	.513	.513	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.374	-.309	.211	-34.343	-.022	.374	.143	38.157

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.255	8.974	.718	.346	.598	.438	95.57	93.37
45	12.828	6.836	.782	.104	.626	.333	110.63	102.50
47		6.588		.076		.321		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
.70	6.284 3.500 18.868	.906 40.807 11.252	.814 .000 12.477	.308 1.638 11.854	18.868 975.250 11.781	11.083 20.503 -5.947	.920 20.459 20.481	26.043 20.481 561.079
5.00	6.363 4.988 19.100	.926 39.328 11.465	.821 .030 12.416	.428 1.316 11.987	19.100 993.934 11.840	11.024 20.527 -4.468	.936 20.467 20.496	27.522 20.497 561.424
9.99	6.442 6.127 19.197	.925 38.189 11.572	.811 .030 12.281	.444 1.309 12.000	19.197 992.529 11.809	11.047 20.483 -3.329	.936 20.436 20.459	28.661 20.459 561.079
14.99	6.521 7.611 19.109	.926 36.705 11.632	.801 .029 12.024	.465 1.397 11.998	19.109 993.820 11.734	10.979 20.499 -1.845	.932 20.490 20.494	30.145 20.494 561.424
19.99	6.600 9.205 18.708	.917 35.111 11.600	.780 .020 11.652	.483 1.798 11.880	18.708 985.801 11.537	10.852 20.509 -.251	.912 20.463 20.486	31.739 20.486 561.424
24.98	6.679 8.435 16.489	.765 35.881 11.430	.656 .026 11.582	.394 4.017 11.477	16.489 840.512 11.263	11.195 20.536 -1.021	.804 20.520 20.528	30.969 20.528 561.424
29.98	6.758 4.121 15.420	.688 40.105 11.180	.615 .023 11.824	.309 5.086 11.248	15.420 763.585 11.218	11.237 20.527 -5.335	.752 20.470 20.498	26.655 20.498 561.424

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 DO, A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O, A T)1
.043 .481 .079	35.04	6.838 2.843 16.793	.777 41.473 11.110	.702 .024 12.128	.333 3.713 11.421	16.793 852.157 11.434	11.271 20.519 -6.613	.819 20.481 20.500	25.377 20.500 561.424
.522 .497 .424	40.24	6.917 4.038 18.526	.885 40.278 11.257	.791 .027 12.322	.396 1.980 11.730	18.526 955.366 11.751	11.137 20.523 -5.418	.903 20.473 20.498	26.572 20.498 561.079
.661 .459 .079	45.04	6.996 6.039 19.441	1.053 38.277 11.525	.925 .030 12.347	.504 1.061 11.960	19.445 1106.447 11.962	9.646 20.523 -3.417	.948 20.484 20.504	28.573 20.504 561.079
.145 .494 .424	50.03	7.075 7.399 19.679	1.053 36.917 11.751	.913 .030 12.253	.525 .824 12.098	19.682 1106.447 12.033	9.764 20.528 -2.057	.960 20.492 20.510	29.933 20.510 561.079
.739 .486 .424	55.03	7.154 8.630 19.468	.961 35.686 11.905	.823 .030 12.088	.498 1.038 12.088	19.468 1025.815 11.970	10.752 20.529 -.816	.949 20.484 20.506	31.164 20.506 561.424
.969 .528 .424	60.03	7.233 9.402 18.716	.885 34.914 11.873	.751 .029 11.884	.468 1.790 12.014	18.716 955.366 11.837	11.251 20.537 -.054	.913 20.486 20.512	31.936 20.512 561.079
.655 .498 .424	65.02	7.312 10.159 17.819	.835 34.157 11.755	.703 .027 11.628	.451 2.686 11.888	17.819 908.972 11.658	11.209 20.521 .713	.869 20.475 20.498	32.693 20.498 561.079

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 10.754 16.585	.760 33.562 11.639	.636 .025 11.445	.417 3.921 11.647	16.585 835.982 11.452	11.309 20.517 1.298	.809 20.459 20.488	33.288 20.488 561.424
75.02	7.470 8.318 14.252	.587 35.998 11.455	.504 .021 11.555	.301 6.254 11.318	14.252 659.461 11.191	11.286 20.533 -1.138	.695 20.474 20.503	30.852 20.503 561.079
80.01	7.549 -3.977 13.253	.485 48.293 11.216	.459 .017 12.003	.154 7.253 11.096	13.253 550.130 11.040	11.286 20.532 -13.433	.646 20.478 20.504	18.557 20.505 561.424
85.01	7.628 -4.815 14.417	.601 49.131 11.046	.573 .018 12.372	.183 6.089 10.976	14.417 674.491 10.951	11.291 20.530 -14.271	.703 20.472 20.501	17.719 20.501 561.424
90.01	7.707 -3.325 15.942	.717 47.641 10.911	.677 .023 12.595	.236 4.564 11.094	15.942 792.925 11.111	11.319 20.533 -12.781	.777 20.485 20.508	19.209 20.509 561.079
95.00	7.786 -.910 17.405	.811 45.226 10.916	.754 .025 12.656	.299 3.101 11.357	17.405 885.126 11.449	11.298 20.534 -10.356	.849 20.476 20.505	21.624 20.505 561.079
100.00	7.865 1.623 18.448	.876 42.693 11.114	.799 .029 12.632	.358 2.058 11.632	18.448 947.231 11.725	11.194 20.533 -7.833	.900 20.478 20.505	24.157 20.505 561.079

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.845 27.683 .865

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 M)2/M)1

.748 .392 17.747 11.127 561.424 1.143 .980

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 MN)2 BETA)2

.702 .392 17.448 11.401 561.424 1.129 .804 29.155

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.880	.865	.546	1.456	.327	1.506	1.248	.189
.044	.516	1.853	.619	1.218	.590	5.149	39.167
30.220	.456						

OVERALL PERFORMANCE

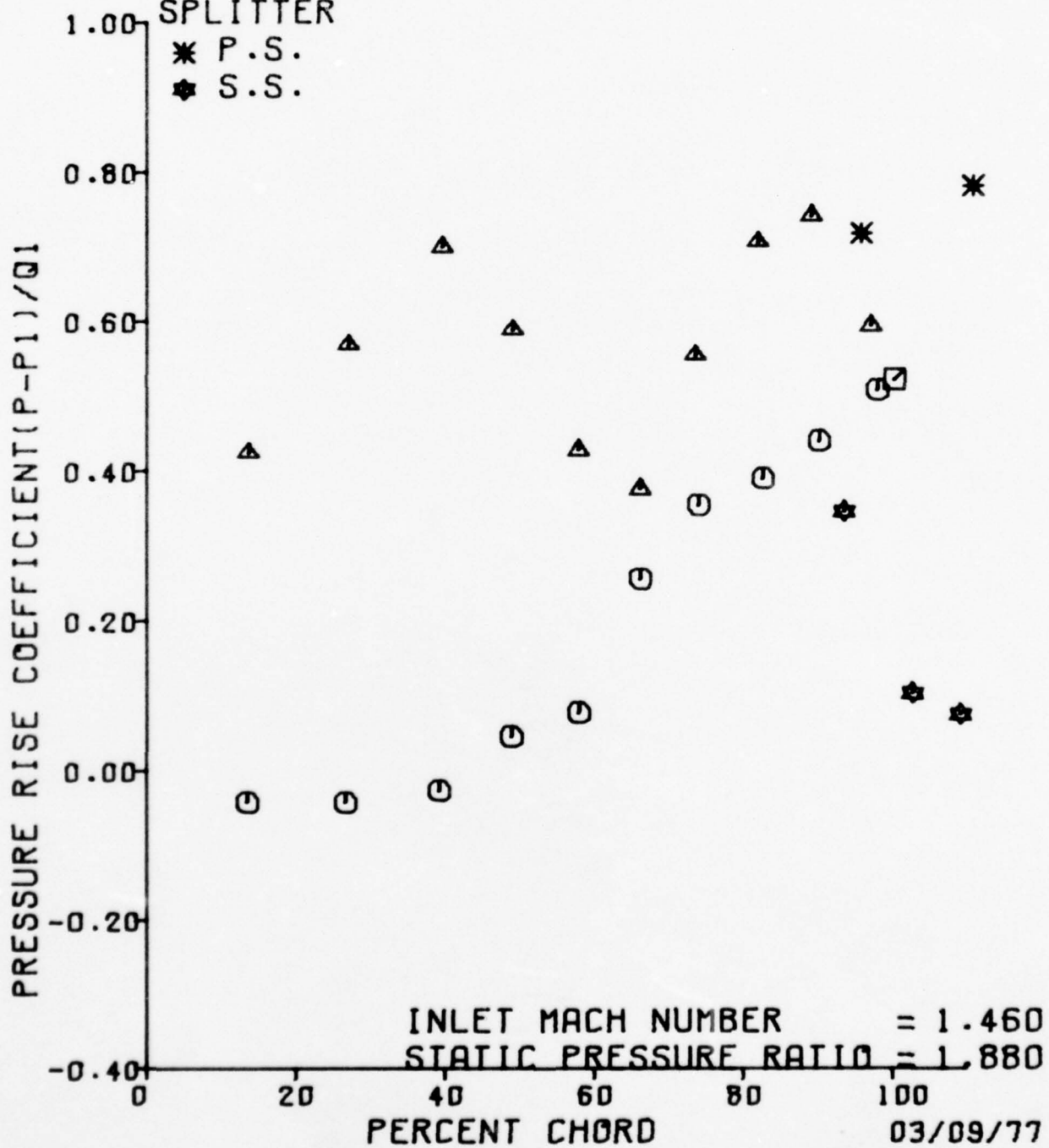
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.926	.851	.619	1.375	.328	1.525	1.263	.210
.048	.544	1.935	.618	1.170	.621	6.621	37.695
26.969	.477						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

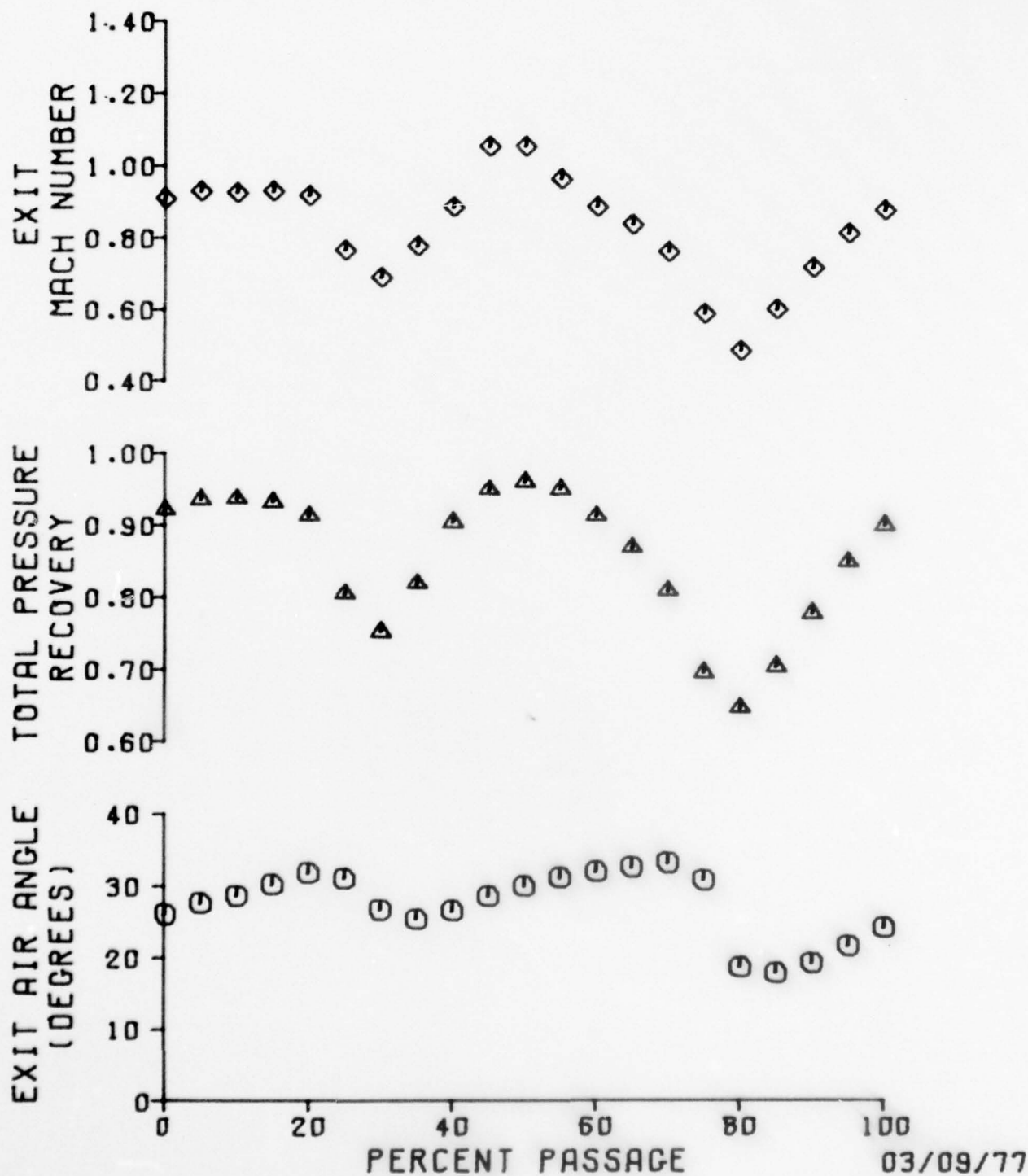


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.880



03/09/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.881	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.081	1.504	58.010	24.333	560.734

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.050

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.527	20.528	20.531	20.532
11	18.406	6.730	10.261	12.044
13	11.311	9.482	11.143	5.598
15	12.762	10.354	12.085	5.772
17	11.790	14.549	11.066	6.685
19	11.891	11.819	9.664	7.070
21	20.476	9.718	9.461	8.621
23	10.701	14.551	11.321	9.415
25	10.678	11.170	12.395	9.634
27	10.934	11.136	12.669	10.157
29	10.822	11.127	11.399	10.721
31	10.632	14.560	10.794	20.542
33	10.968	11.131	10.787	2.098
35	10.731	10.985	10.781	2.351
37	10.745	10.779	10.775	1.604
39	10.776	14.544	10.871	1.542
41	11.178	11.549	10.862	1.773
43	20.514	14.552	12.421	8.945
45	5.131	20.522	12.980	6.826
47	20.513	20.511	20.531	7.119

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	50%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	20.505	560.734	9.284	65.667

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	20.505	560.734	66.850	5.919	.249	8.829
I)SS	I)ML	PN)Y,1	PN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.479

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.701	33	10.968
25	10.678	35	10.731
27	10.934	37	10.745
29	10.822	39	10.776
31	10.632	41	11.178

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
10.753	.113	10.879	.172	1.006	1.817

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.794
		33	10.787
		35	10.781
		37	10.775
		39	10.871
		41	10.862

MEAN TRAILING EDGE PRESSURE [PSIA] 10.811 RMS DEVIATION .039

2

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.098 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.351 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.604 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.542 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.045 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.773 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.307 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.072

11
13
15
17
19
21
23
25
27
29
0

43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.261	5.598	.492	-.036	.500	.273	13.69	13.45
13	11.143	5.598	.592	-.036	.543	.273	26.98	26.63
15	12.085	5.772	.698	-.017	.589	.281	39.60	39.24
17	11.066	5.685	.583	.087	.540	.326	49.07	48.78
19	9.664	7.070	.424	.130	.471	.345	57.88	57.75
21	9.461	8.621	.401	.306	.461	.420	66.00	66.09
23	11.321	9.415	.612	.396	.552	.459	73.41	73.77
25	12.395	9.634	.734	.421	.605	.470	81.70	82.41
27	12.669	10.157	.765	.480	.618	.495	89.05	89.97
29	11.399	10.721	.621	.544	.556	.523	96.93	97.73
0	10.823	10.823	.556	.556	.528	.528	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CD11	CL11	MC1LE	CP1LE
.374	-.310	.209	-34.013	-.024	.373	.137	36.712

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.421	8.945	.737	.343	.606	.436	95.57	93.37
45	12.980	6.826	.800	.103	.633	.333	110.63	102.50
47		7.119		.136		.347		109.00

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN12 TURN P)TP	MN1Y,2 M12 P)BP	MN1Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.284 3.704 18.894	.884 40.612 11.459	.793 .000 12.618	.391 1.610 12.016	18.894 954.200 11.968	11.366 20.509 -5.762	.921 20.480 20.494	26.238 20.495 560.734
5.00	6.363 4.953 19.128	.895 39.363 11.627	.794 .030 12.553	.413 1.376 12.100	19.128 964.740 11.988	11.367 20.525 -4.503	.933 20.481 20.503	27.487 20.503 560.734
9.99	6.442 6.153 19.114	.895 38.163 11.739	.785 .030 12.421	.430 1.391 12.137	19.114 964.740 11.954	11.359 20.545 -3.313	.932 20.499 20.522	28.687 20.522 560.734
14.99	6.521 7.413 18.935	.894 36.903 11.764	.774 .029 12.182	.446 1.569 12.117	18.935 963.308 11.858	11.271 20.533 -2.053	.923 20.494 20.513	29.947 20.514 560.734
19.99	6.600 8.942 18.441	.876 35.374 11.723	.748 .028 11.823	.458 2.063 11.987	18.441 947.197 11.667	11.182 20.549 -.514	.899 20.498 20.523	31.476 20.524 560.734
24.98	6.679 7.635 16.259	.728 36.681 11.543	.630 .025 11.794	.366 4.245 11.619	16.259 803.764 11.444	11.425 20.560 -1.821	.793 20.502 20.530	30.169 20.531 561.079
29.98	6.758 3.737 15.615	.681 40.580 11.365	.611 .023 12.055	.302 4.890 11.452	15.615 756.458 11.415	11.445 20.538 -5.719	.762 20.482 20.510	26.271 20.510 560.734

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

BETA)2 T)0,A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
6.238 0.495 0.734	35.04	6.838 2.855 16.825	.758 41.461 11.312	.585 .024 12.300	.325 3.680 11.630	16.825 833.207 11.624	11.498 20.520 -6.611	.821 20.476 20.498	25.389 20.498 561.079
7.487 0.503 0.734	40.04	6.917 3.927 18.307	.854 40.389 11.421	.764 .027 12.455	.380 2.197 11.844	18.307 925.903 11.850	11.369 20.549 -5.529	.893 20.491 20.520	26.461 20.520 561.079
8.687 0.522 0.734	45.04	6.996 5.551 19.230	.906 38.765 11.656	.799 .029 12.476	.427 1.274 12.089	19.230 974.651 12.056	11.296 20.550 -3.915	.938 20.502 20.525	28.085 20.526 560.734
9.947 0.514 0.734	50.03	7.075 6.900 19.450	.916 37.416 11.841	.798 .030 12.388	.450 1.055 12.190	19.450 983.623 12.139	11.304 20.525 -2.556	.949 20.504 20.514	29.434 20.514 560.734
1.476 0.524 0.734	55.03	7.154 8.242 19.291	.906 36.074 11.988	.778 .030 12.243	.464 1.213 12.207	19.291 974.651 12.075	11.332 20.531 -1.214	.941 20.477 20.503	30.776 20.504 561.079
0.169 0.531 1.079	60.03	7.233 9.025 18.652	.863 35.291 11.990	.736 .028 12.077	.452 1.853 12.173	18.652 934.711 11.974	11.470 20.544 -.451	.910 20.487 20.515	31.559 20.515 560.734
6.271 0.510 0.734	65.02	7.312 9.688 17.852	.820 34.628 11.867	.694 .027 11.830	.437 2.653 12.071	17.852 893.993 11.838	11.474 20.552 .212	.871 20.509 20.530	32.222 20.531 561.079

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.22	7.391 10.173 16.550	.735 34.143 11.773	.618 .025 11.674	.397 3.954 11.854	16.550 810.285 11.659	11.559 20.540 .697	.807 20.492 20.516	32.707 20.516 561.079
75.02	7.470 7.687 14.251	.560 36.629 11.634	.484 .020 11.780	.282 6.254 11.559	14.251 630.972 11.421	11.514 20.550 -1.779	.695 20.493 20.521	32.221 20.522 560.734
80.01	7.549 -3.686 13.433	.476 48.002 11.436	.450 .017 12.190	.154 7.071 11.320	13.433 540.259 11.291	11.504 20.547 -13.152	.655 20.487 20.517	18.848 20.517 561.079
85.01	7.628 -4.310 14.572	.590 48.626 11.284	.561 .018 12.539	.185 5.933 11.224	14.572 662.272 11.195	11.512 20.535 -13.776	.711 20.495 20.514	18.224 20.515 560.734
90.01	7.707 -2.947 15.975	.698 47.263 11.144	.658 .022 12.727	.234 4.530 11.318	15.975 773.373 11.350	11.537 20.506 -12.413	.779 20.501 20.503	19.587 20.504 560.734
95.00	7.786 -1.668 17.386	.790 44.984 11.141	.733 .026 12.791	.294 3.118 11.561	17.386 864.326 11.646	11.522 20.535 -10.134	.848 20.496 20.515	21.866 20.516 561.079
100.00	7.865 1.792 18.452	.859 42.524 11.300	.782 .028 12.756	.354 2.053 11.780	18.452 930.352 11.901	11.402 20.551 -7.674	.900 20.504 20.527	24.326 20.528 561.079

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.805 27.493 .862

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)1 M)2/M)1

.714 .372 17.675 11.536 560.734 1.130 .971

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 MN)2 BETA)2

.681 .372 17.404 11.695 560.735 1.120 .775 28.641

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.949	.862	.622	1.398	.311	1.544	1.263	.194
.045	.547	1.936	.633	1.188	.636	4.959	39.357
28.433	.463						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.976	.849	.599	1.338	.312	1.552	1.273	.213
.049	.567	2.002	.632	1.148	.654	6.107	38.209
25.270	.482						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

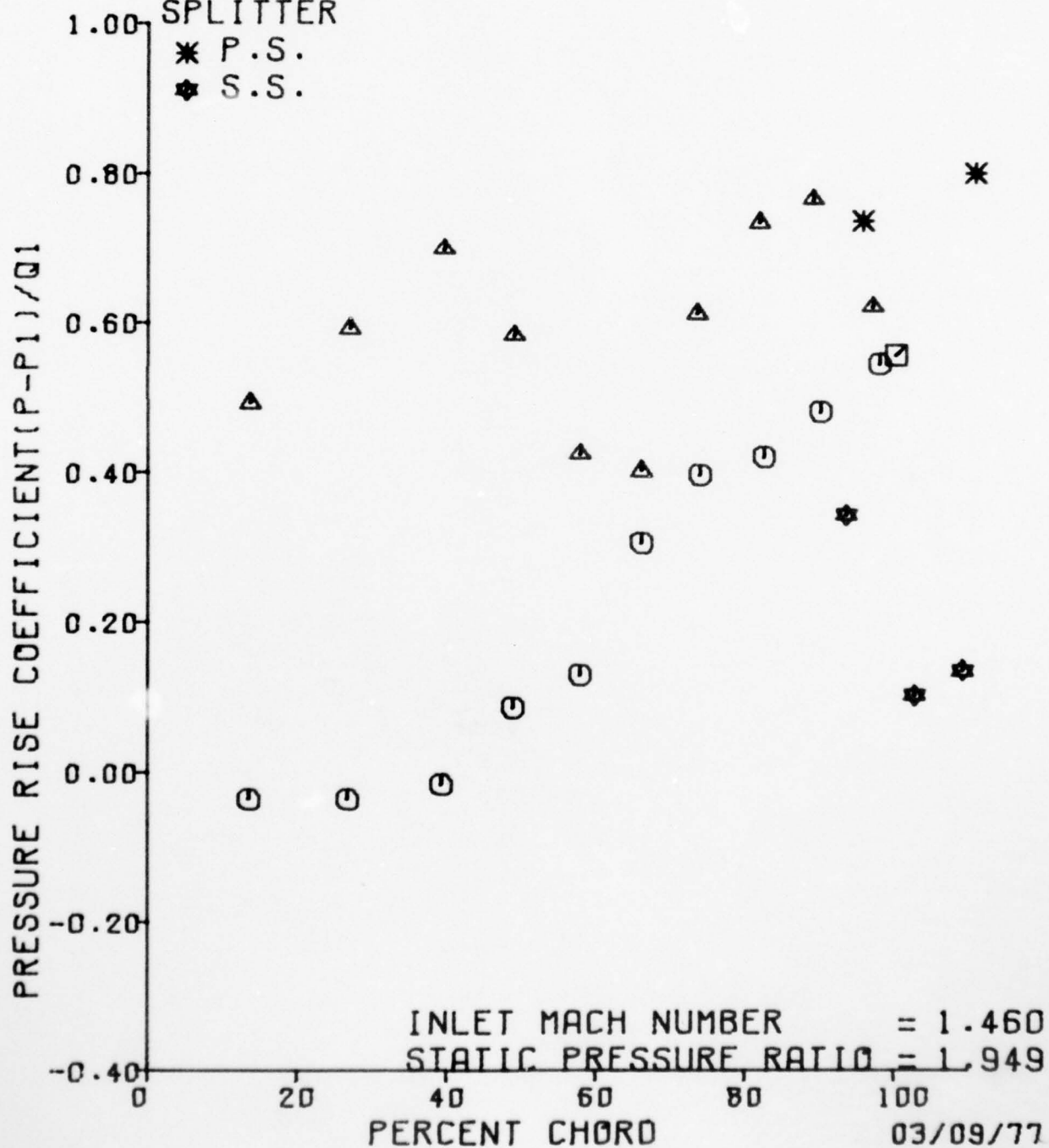
○ S.S.

□ T.E.

SPLITTER

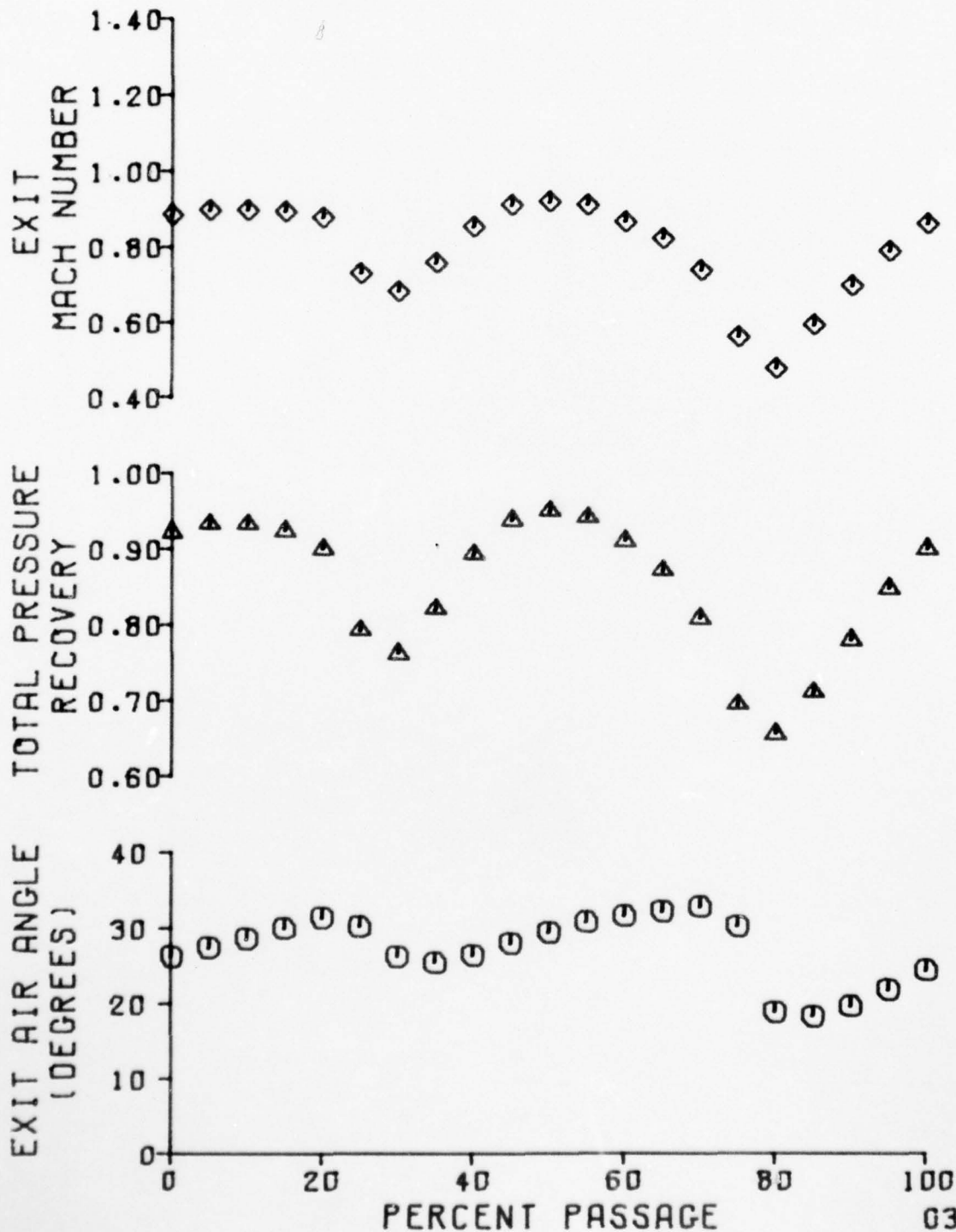
* P.S.

✱ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.949



03/09/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.885	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.867	1.503	57.960	24.310	560.390

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.159	43.093	1.461	1.000	1.059

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 18 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSTA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.523	20.544	20.555	20.551
11	18.671	6.738	10.818	11.933
13	12.011	10.092	11.295	5.742
15	12.477	10.647	12.015	5.685
17	12.308	14.562	10.962	7.161
19	12.298	11.894	9.579	8.158
21	20.481	10.049	9.984	9.189
23	11.096	14.563	11.858	9.842
25	11.065	10.633	12.701	10.044
27	11.250	11.589	12.934	10.623
29	11.169	11.585	11.763	11.171
31	11.073	14.572	11.208	20.535
33	11.413	11.617	11.199	2.102
35	11.171	11.376	11.197	2.367
37	11.157	11.214	11.193	1.611
39	11.218	14.558	11.322	1.565
41	11.548	11.926	11.315	1.769
43	20.521	14.564	12.552	8.902
45	5.124	20.548	13.213	6.797
47	20.546	20.521	20.539	7.809

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION (IN)
39.750	1.185	.045	50%

AD-A043 860

GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER F33615-76-C-2052

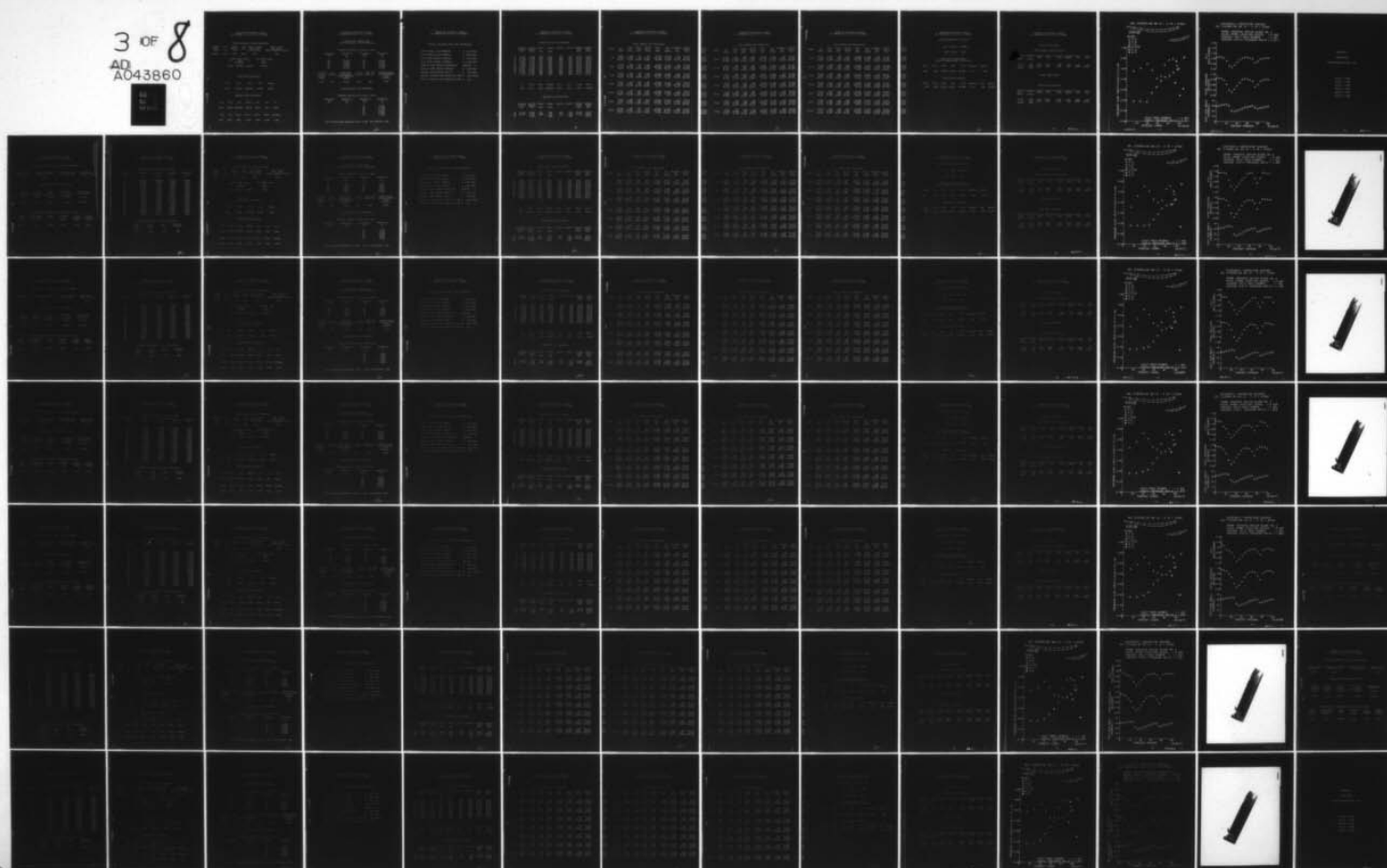
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SUPersonic COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE		EXIT METAL ANGLE	
PS	SS (DEGREES)	ML	ML (DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	20.517	560.390	9.292	65.690

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	20.516	560.390	66.850	5.916	.249	8.833
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.468	1.481

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	11.096	33	11.413
25	11.065	35	11.171
27	11.250	37	11.157
29	11.169	39	11.218
31	11.073	41	11.548

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
11.131	.070	11.301	.154	.977	1.881

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	11.208
		33	11.199
		35	11.197
		37	11.193
		39	11.322
		41	11.315

MEAN TRAILING EDGE PRESSURE (PSIA) 11.239 RMS DEVIATION .056

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.102 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.367 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.611 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.565 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.392 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.759 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.054 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.318 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.074

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.818	5.742	.555	-.020	.527	.280	13.69	13.45
13	11.295	5.742	.609	-.020	.551	.280	26.98	26.63
15	12.015	5.685	.690	-.026	.586	.277	39.60	39.24
17	10.962	7.161	.571	.141	.534	.349	49.07	48.78
19	9.579	8.158	.415	.254	.467	.398	57.88	57.75
21	9.984	9.189	.461	.371	.487	.448	66.00	66.09
23	11.858	9.842	.673	.444	.578	.480	73.41	73.77
25	12.701	10.044	.768	.467	.619	.490	81.70	82.41
27	12.934	10.623	.794	.533	.630	.518	89.05	89.97
29	11.763	11.171	.662	.595	.573	.544	96.93	97.73
3	11.257	11.257	.605	.605	.549	.549	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.362	-.301	.200	-33.672	-.025	.361	.126	34.970

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.552	8.902	.751	.338	.612	.434	95.57	93.37
45	13.213	6.797	.826	.100	.644	.331	110.63	102.50
47		7.899		.224		.385		109.00

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.254	.847	.741	.412	18.835	11.776	.918	29.055
	6.521	37.795	.000	1.681	919.443	20.523	20.479	20.501
	18.835	11.997	12.565	12.382	12.257	-2.965	20.501	560.734
5.00	6.363	.853	.741	.423	18.941	11.776	.923	29.699
	7.165	37.151	.029	1.575	924.580	20.528	20.475	20.502
	18.941	12.087	12.536	12.428	12.259	-2.321	20.501	560.734
9.99	6.442	.854	.733	.437	18.884	11.728	.920	30.791
	8.257	36.059	.028	1.632	925.569	20.564	20.504	20.534
	18.884	12.135	12.372	12.417	12.211	-1.229	20.534	560.734
14.99	6.521	.810	.687	.430	18.239	11.843	.889	32.014
	9.480	34.836	.027	2.278	883.984	20.538	20.499	20.518
	18.239	12.177	12.178	12.391	12.147	-.006	20.518	560.390
19.99	6.600	.703	.591	.380	16.568	11.912	.808	32.723
	10.189	34.127	.025	3.948	778.263	20.539	20.482	20.510
	16.568	12.093	11.999	12.216	11.991	.703	20.510	560.734
24.98	6.679	.522	.452	.261	14.300	11.873	.697	30.008
	7.474	36.842	.020	6.216	590.291	20.524	20.495	20.509
	14.300	11.952	12.099	11.911	11.799	-2.012	20.509	560.390
29.98	6.758	.458	.430	.156	13.668	11.837	.666	19.971
	-2.563	46.879	.016	6.848	520.661	20.534	20.496	20.515
	13.668	11.777	12.426	11.699	11.688	-12.049	20.514	560.734

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

ETA)2 P)O,A T)1	PERCT	Y DEV P)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	FN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A T)1
2.055 2.501 2.734	35.04	6.838 -3.216 14.728	.566 47.532 11.638	.534 .018 12.725	.187 5.788 11.610	14.728 636.445 11.642	11.853 20.542 -12.702	.718 20.488 20.515	19.318 20.515 560.734
2.699 2.502 2.734	40.04	6.917 -2.054 15.961	.665 46.370 11.520	.623 .022 12.869	.233 4.555 11.685	15.961 739.267 11.727	11.868 20.548 -11.540	.778 20.522 20.534	20.488 20.535 560.390
2.791 2.534 2.734	45.04	6.906 -.140 17.312	.758 44.457 11.495	.701 .025 12.973	.289 3.204 11.881	17.312 832.911 11.915	11.832 20.574 -9.626	.844 20.526 20.549	22.394 20.550 560.734
2.014 2.518 2.390	50.03	7.075 2.155 18.403	.820 42.161 11.622	.745 .028 12.941	.343 2.113 12.098	18.403 893.718 12.141	11.829 20.531 -7.331	.897 20.484 20.506	24.689 20.507 560.734
2.723 2.510 2.734	55.03	7.154 4.228 18.865	.855 40.088 11.783	.763 .029 12.799	.385 1.651 12.175	18.865 926.759 12.233	11.701 20.534 -5.258	.920 20.509 20.521	26.762 20.522 560.734
2.008 2.509 2.390	60.03	7.233 5.300 18.712	.847 39.016 11.863	.749 .029 12.657	.396 1.805 12.121	18.712 919.219 12.226	11.702 20.574 -4.186	.912 20.530 20.551	27.834 20.552 560.390
2.971 2.515 2.734	65.02	7.312 6.422 18.391	.830 37.894 11.883	.726 .028 12.442	.402 2.125 12.065	18.391 902.821 12.203	11.707 20.555 -3.064	.896 20.535 20.544	28.956 20.545 560.734

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.22	7.391	.801	.693	.403	17.836	11.687	.869	32.162
	7.626	36.690	.027	2.680	875.242	20.532	20.508	20.520
	17.836	11.870	12.187	11.939	12.134	-1.860	20.519	560.734
75.22	7.470	.657	.586	.297	15.742	11.780	.767	26.892
	4.358	39.958	.024	4.774	731.599	20.530	20.503	20.516
	15.742	11.741	12.335	11.688	11.827	-5.128	20.516	560.734
80.21	7.549	.715	.647	.303	16.571	11.794	.808	25.100
	2.566	41.750	.023	3.945	789.912	20.571	20.519	20.545
	16.571	11.630	12.576	11.736	11.841	-6.920	20.544	560.390
85.21	7.628	.801	.718	.355	17.899	11.731	.872	26.324
	3.790	40.526	.026	2.617	875.014	20.568	20.524	20.546
	17.899	11.645	12.617	11.941	12.049	-5.696	20.545	560.734
90.21	7.707	.820	.729	.376	18.352	11.795	.895	27.279
	4.745	39.571	.028	2.164	893.718	20.540	20.487	20.514
	18.352	11.755	12.607	12.095	12.182	-4.741	20.513	560.734
95.20	7.786	.844	.741	.404	18.732	11.750	.913	28.612
	6.078	38.238	.028	1.784	916.492	20.512	20.520	20.516
	18.732	11.923	12.568	12.255	12.281	-3.408	20.515	560.390
100.20	7.865	.833	.724	.412	18.626	11.820	.908	29.644
	7.110	37.206	.028	1.890	905.713	20.512	20.500	20.506
	18.626	12.040	12.482	12.303	12.298	-2.376	20.505	560.734

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.769 27.183 .857

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 M)2/M)1

.684 .351 17.586 11.895 560.390 1.118 .957

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 MN)2 BETA)2

.655 .351 17.365 12.034 560.390 1.110 .743 28.203

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

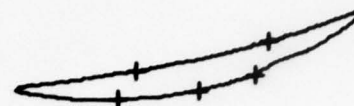
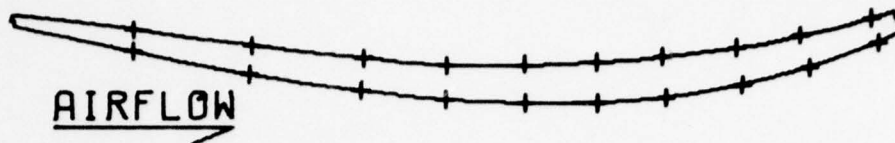
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.011	.857	.595	1.345	.295	1.576	1.276	.201
.047	.576	2.021	.648	1.156	.677	4.649	39.667
26.114	.472						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.034	.846	.577	1.293	.296	1.583	1.285	.215
.050	.593	2.083	.647	1.121	.693	5.669	38.647
22.893	.488						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

△ P.S.

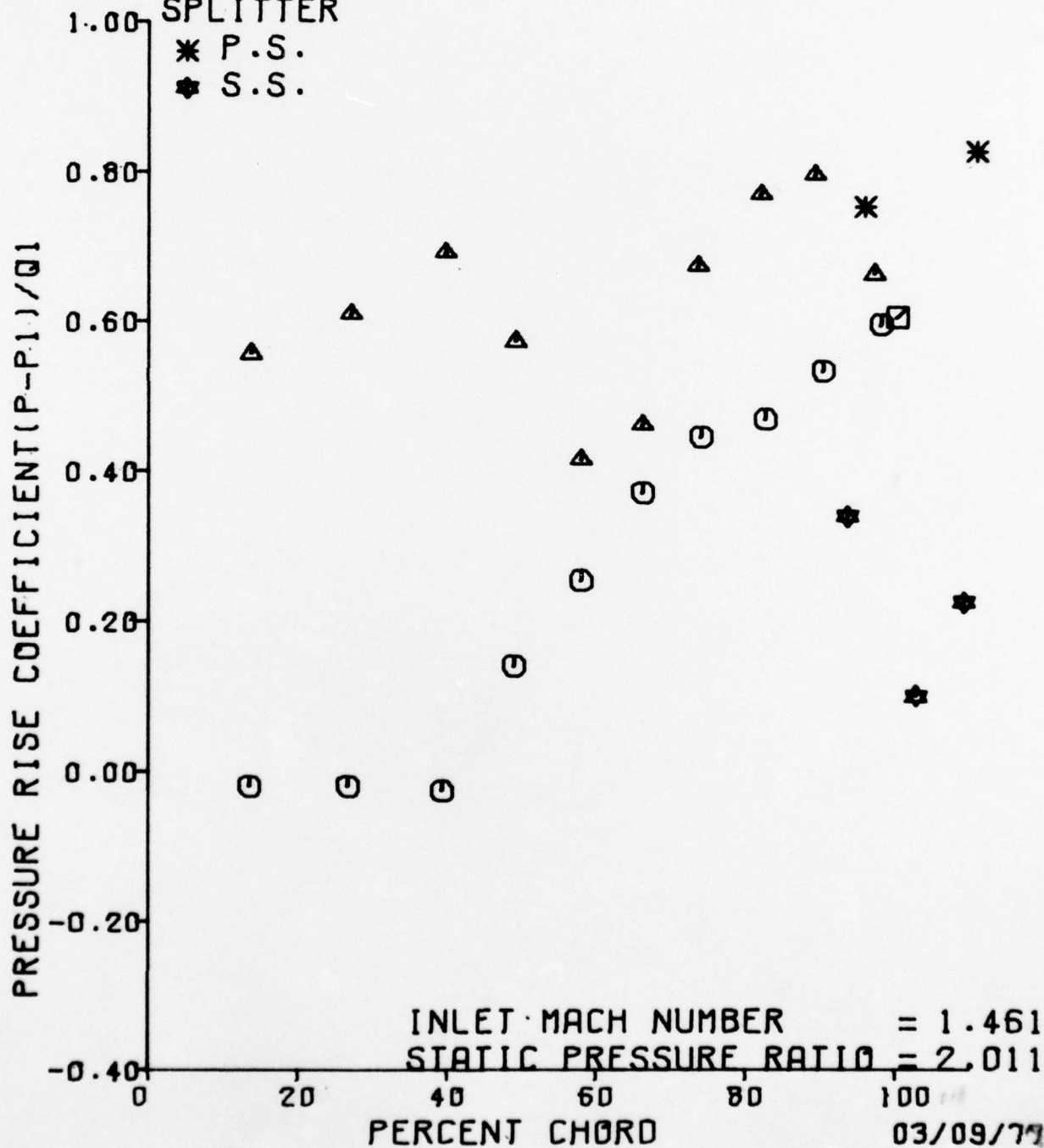
○ S.S.

□ T.E.

SPLITTER

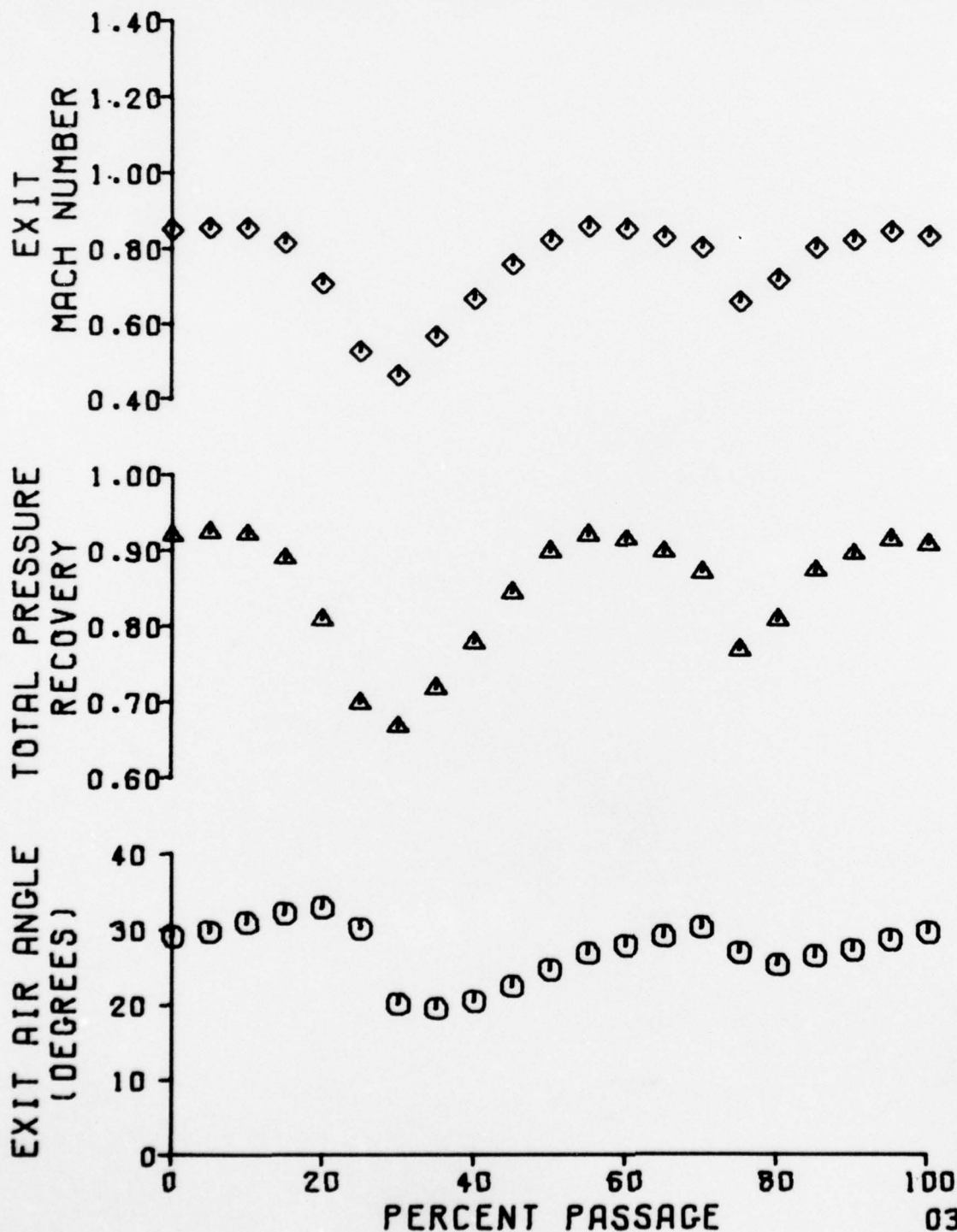
* P.S.

★ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 2.011



APPENDIX D

CASCADE DATA

SPLITTER VANE POSITION = 52%

$$P)_2/P)_1 = 1.683$$

$$P)_2/P)_1 = 1.750$$

$$P)_2/P)_1 = 1.818$$

$$P)_2/P)_1 = 1.894$$

$$P)_2/P)_1 = 1.941$$

$$P)_2/P)_1 = 1.995$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.755	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ.) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.875	1.505	57.990	24.290	563.493

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.147	43.079	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.682	19.676	19.663	19.683
11	18.560	8.542	8.254	1.717
13	11.178	8.138	9.976	5.280
15	11.377	9.027	11.628	5.280
17	11.350	14.536	10.799	5.424
19	11.307	10.985	9.506	6.269
21	19.596	10.368	9.022	7.289
23	9.363	14.537	9.320	8.032
25	9.500	10.380	11.204	8.483
27	9.858	8.366	11.705	8.687
29	9.780	9.677	10.033	9.375
31	9.497	14.548	9.486	19.669
33	9.827	9.536	9.479	2.060
35	9.530	10.537	9.472	2.705
37	9.421	9.604	9.468	1.585
39	9.607	14.532	9.546	1.601
41	10.034	10.435	9.537	1.760
43	19.655	14.540	10.803	8.723
45	4.375	19.657	11.998	3.087
47	19.655	19.647	19.659	5.136

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	52%

2

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.644	563.493	8.872	65.701

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.644	563.493	66.850	5.661	.238	8.458
I)SS	I)ML	PN)Y,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.470	1.408

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.363	33	9.827
25	9.509	35	9.530
27	9.858	37	9.421
29	9.780	39	9.607
31	9.497	41	10.034

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.601	.186	9.684	.220	1.065	1.696

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.486
		33	9.479
		35	9.472
		37	9.468
		39	9.546
		41	9.537

MEAN TRAILING EDGE PRESSURE (PSIA) 9.498 RMS DEVIATION .031

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.060 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.705 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.585 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.601 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.734 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.760 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.044 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.288 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.071

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.254	5.280	.307	-.045	.420	.260	13.69	13.45
13	9.976	5.280	.510	-.045	.508	.269	26.98	26.63
15	11.628	5.280	.706	-.045	.592	.269	39.60	39.24
17	10.799	5.424	.608	-.028	.550	.276	49.07	48.78
19	9.506	5.269	.455	.072	.484	.319	57.88	57.75
21	9.022	7.089	.397	.159	.459	.361	66.00	66.09
23	9.320	8.032	.433	.280	.474	.409	73.41	73.77
25	11.204	8.483	.655	.334	.570	.432	81.70	82.41
27	11.705	8.687	.715	.358	.596	.442	89.05	89.97
29	10.333	9.375	.552	.439	.526	.477	96.93	97.73
0	9.507	9.507	.455	.455	.484	.484	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.371	-.304	.214	-35.134	-.017	.371	.153	41.073

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	10.803	8.723	.608	.362	.550	.444	95.57	93.37
45	11.998	3.087	.749	-.304	.611	.157	110.63	102.50
47		5.136		-.062		.261		109.00

2

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A T111
.00	6.284	1.127	.971	.571	19.032	8.624	.969	32.482
	7.948	36.368	.000	.612	1170.607	19.662	19.610	19.636
	18.993	11.150	11.527	11.432	11.346	-1.528	19.635	563.493
5.00	6.363	1.127	.963	.584	19.105	8.657	.973	31.234
	8.700	35.616	.029	.530	1170.607	19.698	19.638	19.668
	19.065	11.256	11.448	11.475	11.362	-.776	19.668	563.493
9.00	6.442	1.131	.956	.604	19.074	8.590	.971	32.294
	9.760	34.556	.028	.570	1174.631	19.688	19.671	19.679
	19.030	11.338	11.270	11.466	11.300	.274	19.679	563.493
14.00	6.521	1.112	.923	.621	18.474	8.521	.940	33.910
	11.376	32.940	.028	1.170	1158.783	19.687	19.606	19.646
	18.447	11.317	10.867	11.292	11.046	1.890	19.646	563.493
19.00	6.600	.846	.690	.492	16.628	10.394	.846	35.471
	12.937	31.379	.025	3.016	922.201	19.672	19.637	19.655
	16.628	11.151	10.564	10.981	10.728	3.461	19.654	563.148
24.00	6.679	.525	.518	.350	13.641	10.483	.694	34.049
	11.515	32.801	.020	6.004	700.379	19.749	19.690	19.719
	13.641	10.818	10.628	10.548	10.333	2.029	19.719	563.148
29.00	6.758	.485	.458	.161	12.217	10.399	.622	19.322
	-3.212	47.528	.016	7.427	551.803	19.683	19.634	19.658
	12.217	10.347	11.032	10.294	10.131	-12.698	19.658	563.493

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 DO,A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A T)1
.482 .636 .493	35.24	6.838 -5.647 13.387	.604 49.963 10.174	.578 .017 11.481	.175 6.257 10.229	13.387 678.392 10.116	10.464 19.686 -15.123	.681 19.633 19.660	16.887 19.660 563.493
.234 .668 .493	40.24	6.917 -3.629 14.949	.729 47.945 10.861	.689 .021 11.710	.236 4.695 10.271	14.949 805.128 10.367	10.500 19.671 -13.115	.761 19.635 19.653	18.905 19.653 563.148
.294 .679 .493	45.24	6.996 -1.167 16.540	.837 45.483 10.886	.780 .025 11.843	.305 3.104 10.543	16.540 912.422 10.824	10.449 19.666 -10.653	.842 19.629 19.647	21.367 19.648 563.493
.910 .646 .493	50.23	7.075 1.930 17.827	.929 42.386 10.356	.846 .028 11.854	.385 1.817 10.851	17.827 998.455 11.114	10.208 19.714 -7.546	.908 19.667 19.690	24.464 19.690 563.493
.471 .655 .148	55.23	7.154 4.650 18.422	1.097 39.666 10.636	.976 .029 11.769	.501 1.204 11.057	18.440 1145.909 11.225	8.673 19.699 -4.826	.939 19.654 19.676	27.184 19.677 563.493
.049 .719 .148	60.23	7.233 6.146 18.618	1.120 38.170 10.795	.983 .029 11.597	.537 .993 11.093	18.651 1165.155 11.175	8.521 19.692 -3.340	.949 19.639 19.666	28.680 19.666 563.838
.322 .658 .493	65.22	7.312 7.922 18.496	1.127 36.394 10.846	.971 .028 11.221	.571 1.110 11.000	18.534 1170.607 11.055	8.398 19.683 -1.563	.943 19.628 19.655	30.456 19.655 563.493

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	NN)2 TURN P)TP	NN)X,2 M)2 P)BP	NN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.391 8.211 17.315	.915 36.105 10.780	.787 .027 11.023	.462 2.329 10.737	17.315 985.538 10.767	10.070 19.733 -1.275	.881 19.675 19.704	30.745 19.704 563.838
75.02	7.470 2.086 15.295	.749 42.230 10.468	.681 .025 11.460	.312 4.349 10.477	15.295 825.282 10.561	10.543 19.697 -7.400	.779 19.640 19.668	24.620 19.669 563.493
80.01	7.549 2.574 17.750	.929 41.742 10.402	.841 .026 11.766	.394 1.894 10.728	17.750 997.929 10.952	10.170 19.665 -6.902	.904 19.606 19.636	25.108 19.636 563.838
85.01	7.628 5.115 18.888	1.143 39.201 10.628	1.013 .029 11.703	.531 .700 11.060	18.944 1184.401 11.220	8.404 19.669 -4.361	.964 19.641 19.655	27.649 19.655 563.493
90.01	7.707 6.509 18.847	1.127 37.807 10.909	.985 .029 11.636	.547 .758 11.265	18.886 1170.607 11.300	8.557 19.683 -2.977	.961 19.631 19.657	29.043 19.657 563.148
95.00	7.786 7.565 18.839	1.113 36.751 11.074	.963 .029 11.540	.558 .777 11.371	18.867 1159.489 11.327	8.603 19.589 -1.921	.960 19.636 19.663	30.009 19.663 563.493
100.00	7.865 8.409 18.617	1.100 35.907 11.165	.943 .028 11.422	.566 1.007 11.402	18.637 1148.449 11.342	8.729 19.686 -1.077	.949 19.659 19.672	30.943 19.673 563.838

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.973 27.905 .890

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.860	.456	17.490	9.529	563.493	1.189	1.013

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.750	.452	17.121	10.299	563.493	1.156	.884	30.715

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

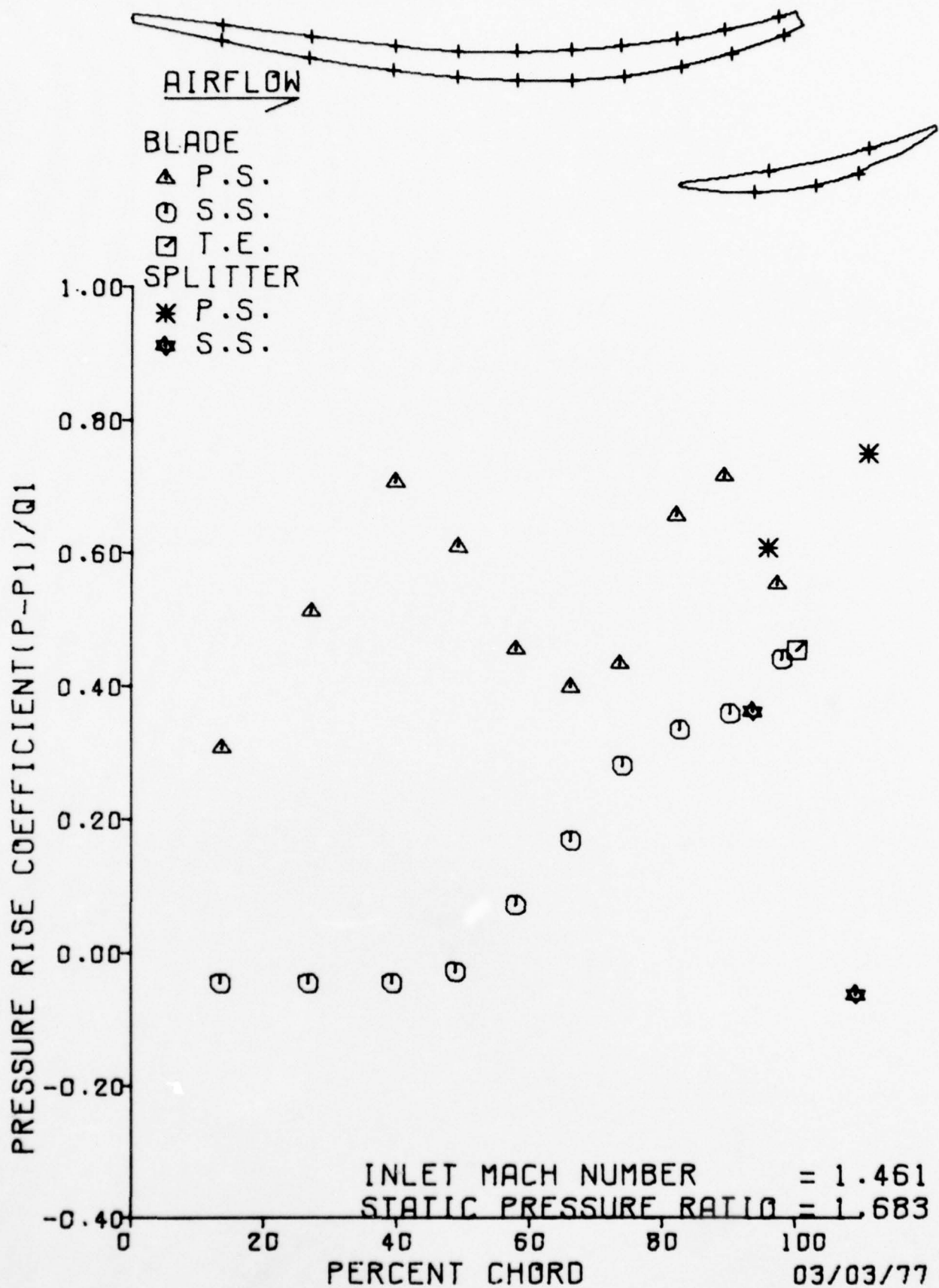
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.683	.890	.730	1.640	.371	1.403	1.200	.154
.036	.422	1.635	.576	1.258	.457	5.371	38.945
34.749	.434						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

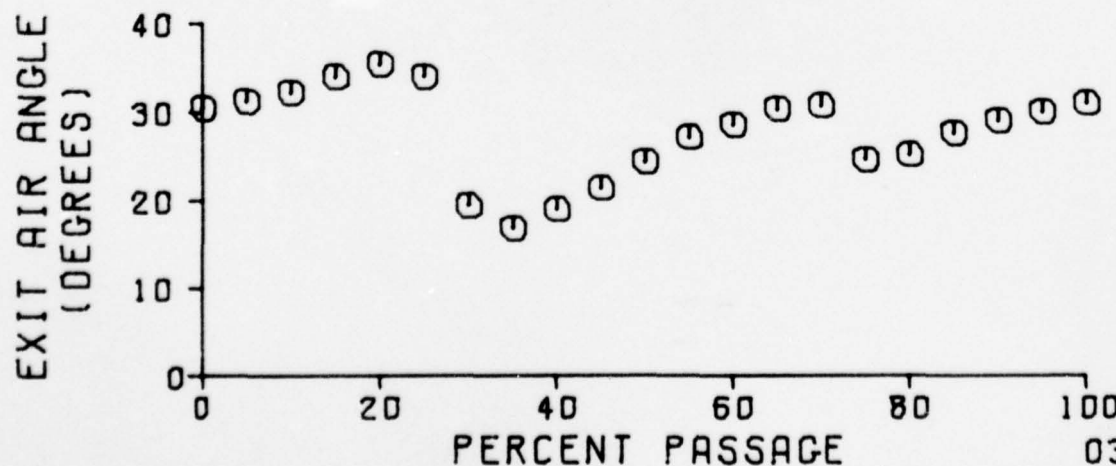
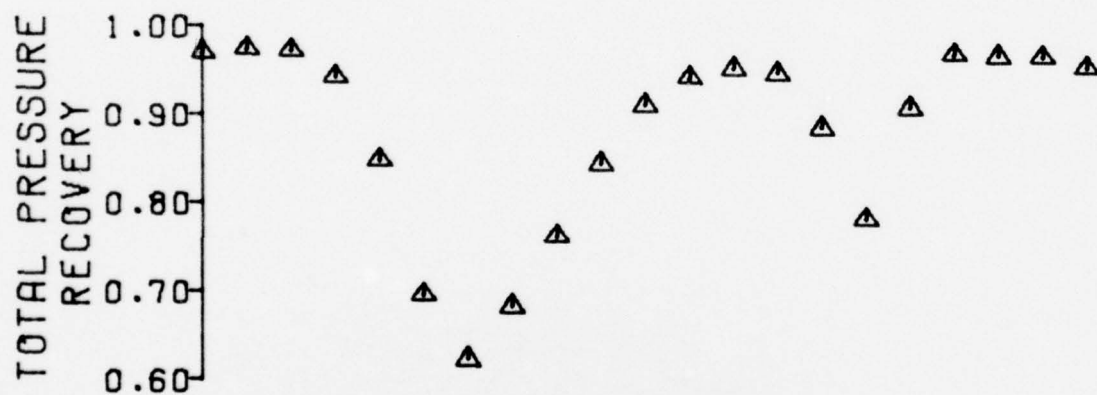
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.819	.872	.672	1.470	.373	1.474	1.234	.180
.041	.470	1.774	.576	1.192	.548	8.181	36.135
31.901	.461						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.683





326675

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.683

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.779	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG. R)
7.875	1.504	57.980	24.296	563.493

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.146	43.078	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.713	19.714	19.715	19.730
11	18.342	6.559	8.918	1.720
13	11.237	8.359	10.138	5.285
15	11.467	9.490	11.690	5.461
17	11.420	14.537	10.817	5.693
19	11.379	11.142	9.529	6.578
21	19.641	10.401	9.090	7.485
23	9.588	14.537	9.653	8.389
25	9.718	10.395	11.453	8.671
27	10.058	8.432	11.850	9.016
29	9.994	9.956	10.546	9.651
31	9.731	14.548	9.764	19.739
33	10.042	9.880	9.760	2.040
35	9.751	10.731	9.754	2.749
37	9.654	9.842	9.749	1.591
39	9.845	14.534	9.815	1.612
41	10.245	10.628	9.808	1.758
43	19.710	14.540	11.246	8.758
45	4.904	19.698	12.106	3.066
47	19.690	19.686	19.674	5.229

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	52%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.884	1.581	.836	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.681	563.493	8.889	65.724

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.681	563.493	66.850	5.671	.238	8.474
I)SS	I)ML	MN)Y,1	MN)Y,1	TT/TT1	PT/P)1	NR/10**6
1.371	3.482	.574	1.343	1.427	3.470	1.411

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.588	33	10.042
25	9.718	35	9.751
27	10.058	37	9.654
29	9.994	39	9.845
31	9.731	41	10.245

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.818	.178	9.907	.212	1.048	1.731

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.764
		33	9.760
		35	9.754
		37	9.749
		39	9.815
		41	9.808

MEAN TRAILING EDGE PRESSURE [PSIA] 9.775 RMS DEVIATION .026

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.040 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.749 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.591 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.612 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.758 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.038 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.269 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.066

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.918	5.285	.383	-.046	.453	.269	13.69	13.45
13	10.138	5.285	.527	-.046	.515	.269	26.98	26.63
15	11.690	5.461	.710	-.025	.594	.277	39.60	39.24
17	10.817	5.693	.607	.003	.550	.289	49.07	48.78
19	9.529	6.578	.455	.107	.484	.334	57.88	57.75
21	9.000	7.485	.403	.214	.462	.380	66.00	66.09
23	9.653	8.389	.470	.321	.490	.426	73.41	73.77
25	11.453	8.671	.582	.354	.582	.441	81.70	82.41
27	11.859	9.016	.730	.395	.603	.458	89.05	89.97
29	10.546	9.651	.575	.470	.536	.490	96.93	97.73
3	9.782	9.782	.485	.485	.497	.497	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	CD1LE	CD1LE
.374	-.308	.213	-34.736	-.019	.374	.148	39.446

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.246	8.758	.658	.364	.571	.445	95.57	93.37
45	12.106	3.066	.759	-.307	.615	.156	110.63	102.50
47		5.229		-.052		.266		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	FN)2 TURN P)TP	MN)Y,2 M)2 P)BP	FN)Y,2 DP)1,2 P)NP	PT)2 V)2 F)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,4 T)1
.20	6.284 7.060 18.083	1.116 36.356 11.213	.061 .000 11.587	.566 .667 11.508	19.014 1161.716 11.421	8.732 19.687 -1.526	.966 19.651 19.668	32.494 19.669 563.493
5.20	6.363 8.721 19.055	1.115 35.595 11.362	.053 .029 11.550	.578 .596 11.582	19.085 1160.963 11.437	8.774 19.695 -1.765	.970 19.645 19.670	31.255 19.670 563.493
9.09	6.442 9.815 18.972	1.115 34.501 11.443	.042 .028 11.362	.597 .679 11.561	19.002 1160.906 11.369	8.737 19.699 .329	.966 19.646 19.672	32.349 19.672 563.493
14.09	6.521 11.346 18.085	.925 32.968 11.374	.768 .027 10.999	.516 1.596 11.380	18.085 994.333 11.138	10.407 19.690 1.862	.919 19.609 19.649	33.882 19.650 563.493
19.09	6.600 12.697 16.530	.820 31.619 11.263	.670 .025 10.742	.473 3.151 11.111	16.530 896.189 10.840	10.624 19.714 3.201	.840 19.660 19.692	35.231 19.692 563.838
24.08	6.679 11.239 13.789	.622 33.077 10.932	.517 .020 10.767	.346 5.892 10.698	13.789 697.616 10.479	10.628 19.719 1.753	.701 19.632 19.676	33.773 19.676 563.838
29.08	6.758 -1.023 12.293	.470 46.239 10.554	.440 .016 11.135	.165 7.388 10.481	12.293 535.032 10.330	10.568 19.654 -11.400	.625 19.599 19.626	20.611 19.626 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

Y C, A 31	PERCT	Y DEV PT)Y P	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DF)1,2 P)RP	PT)2 V)2 P)SP	P)2 PT)C BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)C, A T)1
404 669 493	35.24	8.838 -4.787 13.398	.579 49.283 10.371	.551 .017 11.515	.177 6.374 10.392	13.398 652.311 10.289	10.693 19.798 -14.253	.676 19.649 19.677	17.767 19.677 563.838
255 672 493	40.24	6.917 -3.347 14.786	.790 47.663 10.249	.661 .021 11.764	.230 4.895 10.441	14.786 776.970 10.548	10.663 19.758 -12.833	.751 19.798 19.733	19.187 19.733 563.838
349 672 493	45.24	6.996 -1.844 16.320	.898 45.160 10.258	.751 .024 11.876	.299 3.361 10.612	16.320 884.210 10.889	10.622 19.680 -10.330	.829 19.629 19.654	21.690 19.654 563.493
882 658 493	50.23	7.075 1.596 17.574	.898 43.720 10.444	.812 .027 11.924	.364 2.197 10.698	17.574 962.443 11.179	10.500 19.678 -7.890	.893 19.655 19.666	24.133 19.666 563.838
231 692 638	55.23	7.154 4.071 18.276	.964 40.245 10.718	.862 .028 11.857	.432 1.405 11.127	18.276 1030.129 11.299	10.063 19.721 -5.415	.929 19.690 19.706	26.695 19.706 563.838
773 676 638	60.23	7.233 6.093 18.481	1.077 38.313 10.867	.948 .029 11.673	.515 1.270 11.140	18.411 1129.183 11.264	8.869 19.685 -3.483	.935 19.632 19.658	28.537 19.658 563.493
11 26 638	65.22	7.312 7.658 18.307	1.087 36.856 10.937	.940 .028 11.361	.547 1.361 11.084	18.320 1137.609 11.178	8.717 19.663 -1.828	.931 19.611 19.637	30.192 19.637 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MM)2 TURN P)TP	MM)Y,2 M)2 P)BP	MM)Y,2 DP)1,2 P)MP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.72	7.391 7.759 17.157	.881 36.557 10.871	.761 .027 11.185	.444 2.525 10.821	17.157 953.859 10.905	10.352 19.688 -1.727	.872 19.640 19.664	30.293 19.664 563.838
75.72	7.470 1.541 15.424	.740 42.775 10.584	.675 .025 11.641	.302 4.257 10.626	15.424 817.620 10.724	10.719 19.709 -7.945	.784 19.664 19.666	24.075 19.687 563.838
80.71	7.549 2.779 17.904	.925 41.537 10.534	.836 .026 11.868	.396 1.777 10.846	17.904 994.761 11.088	10.298 19.673 -6.707	.910 19.618 19.645	25.313 19.645 563.838
85.71	7.626 5.039 18.839	1.117 39.277 10.789	.990 .029 11.868	.517 .811 11.200	18.871 1163.040 11.347	8.649 19.659 -4.447	.959 19.629 19.644	27.573 19.644 563.838
90.71	7.707 6.455 18.838	1.107 37.861 11.020	.968 .029 11.753	.536 .819 11.373	18.863 1153.987 11.438	8.763 19.665 -3.031	.958 19.624 19.645	28.989 19.645 563.838
95.70	7.786 7.605 18.748	1.101 36.711 11.168	.952 .029 11.620	.553 .912 11.424	18.769 1149.510 11.422	8.777 19.682 -1.881	.954 19.632 19.657	30.139 19.657 563.493
100.00	7.865 8.193 18.343	.924 36.123 11.234	.795 .028 11.498	.472 1.338 11.427	18.343 994.014 11.386	10.560 19.711 -1.293	.932 19.669 19.690	30.727 19.690 563.493

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.933 27.898 .884

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)2	P)2/M)1
.825	.437	17.395	9.920	563.493	1.174	1.004

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)2	M)2	BETA)2
.739	.433	17.053	10.558	563.493	1.147	.857	30.372

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLE	DF	DF/EQ	DV/Y	FN12	DPS/Q1	DEV	TURN
BETA10	A12/A11						
1.749	.884	.794	1.583	.358	1.439	1.215	.163
.038	.451	1.697	.590	1.235	.501	5.364	38.952
33.853	.439						

OVERALL PERFORMANCE

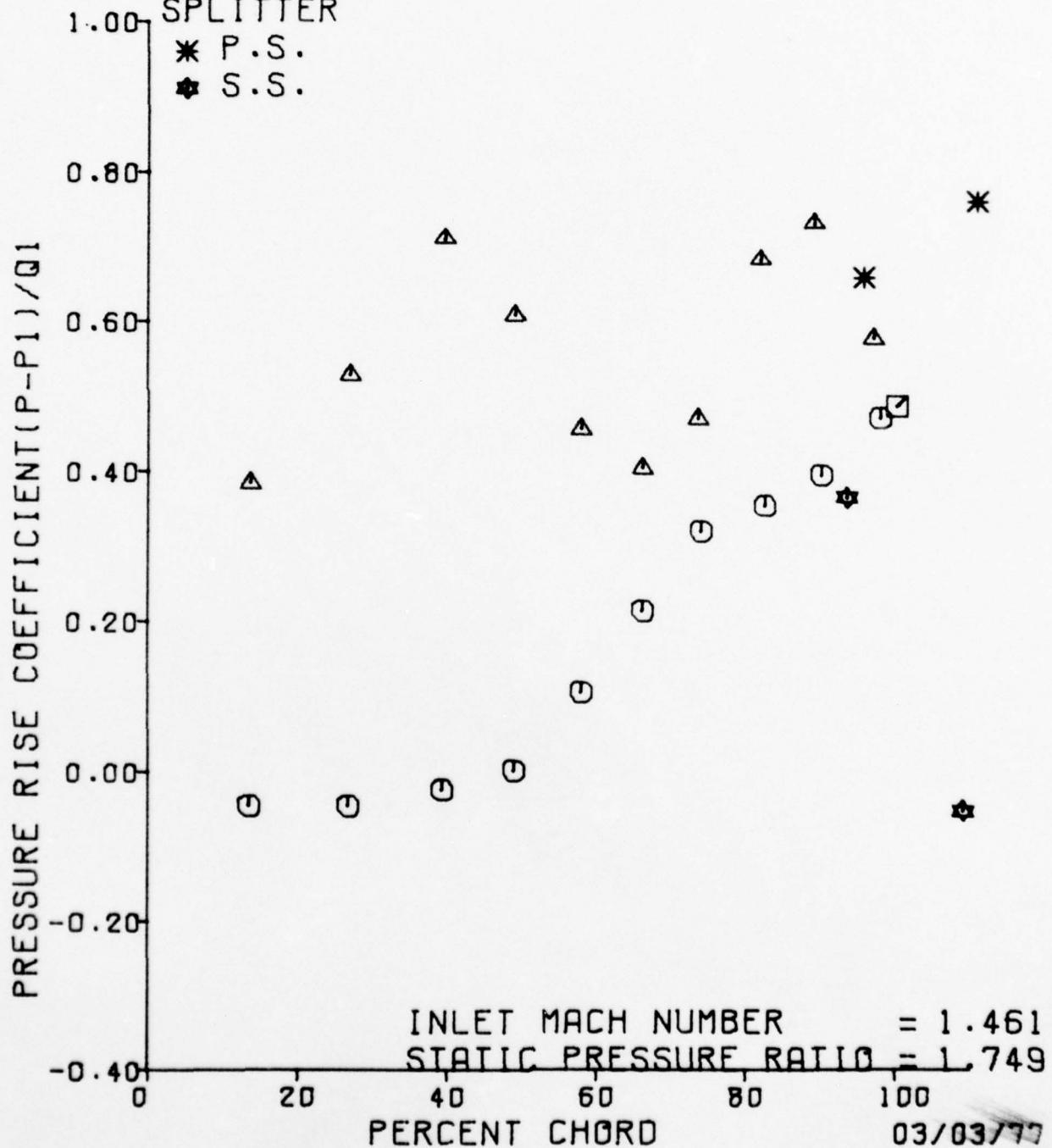
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLE	DF	DF/EQ	DV/Y	FN12	DPS/Q1	DEV	TURN
BETA10	A12/A11						
1.862	.866	.654	1.435	.350	1.495	1.244	.188
.043	.501	1.826	.589	1.172	.577	7.838	36.478
30.727	.466						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

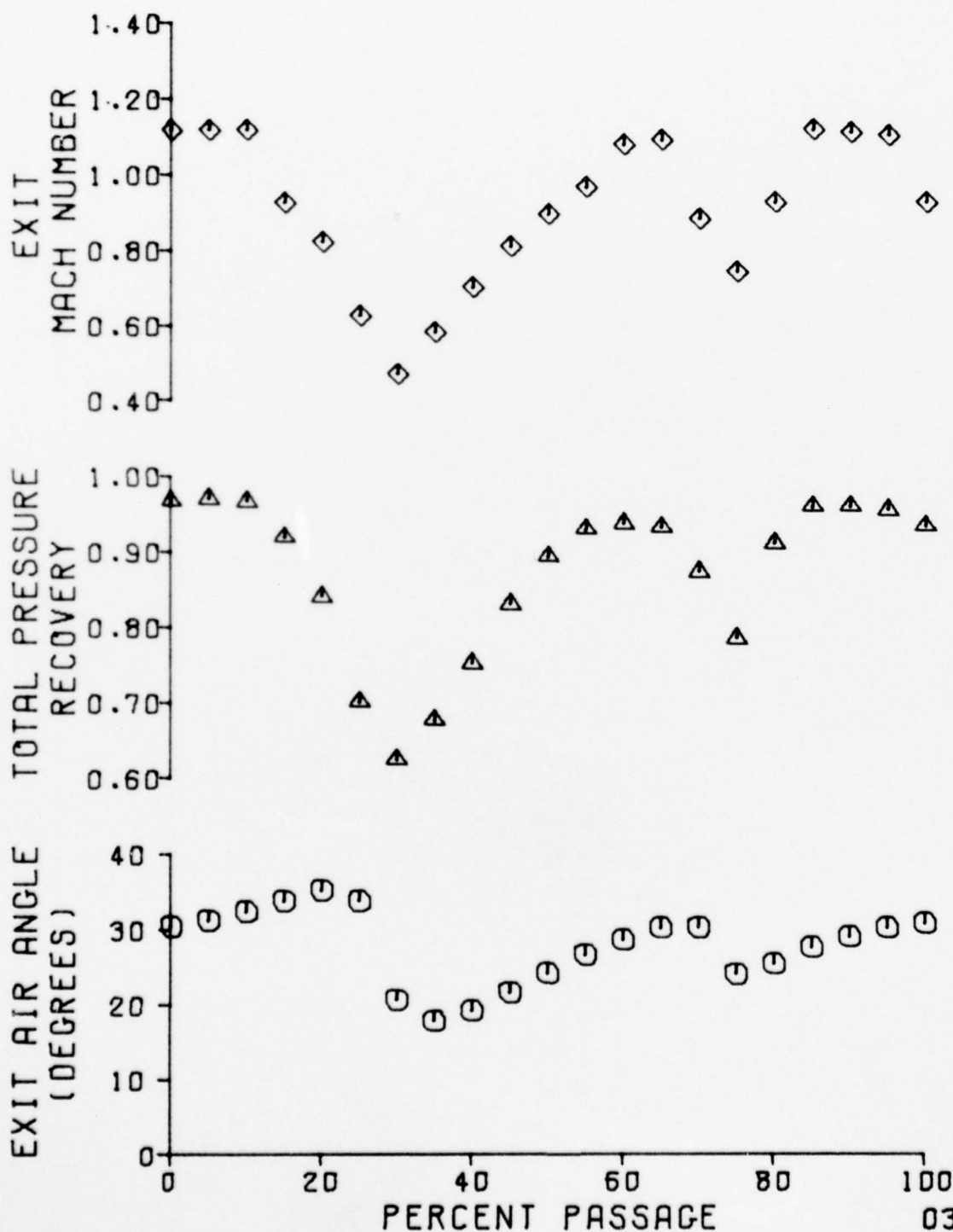


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



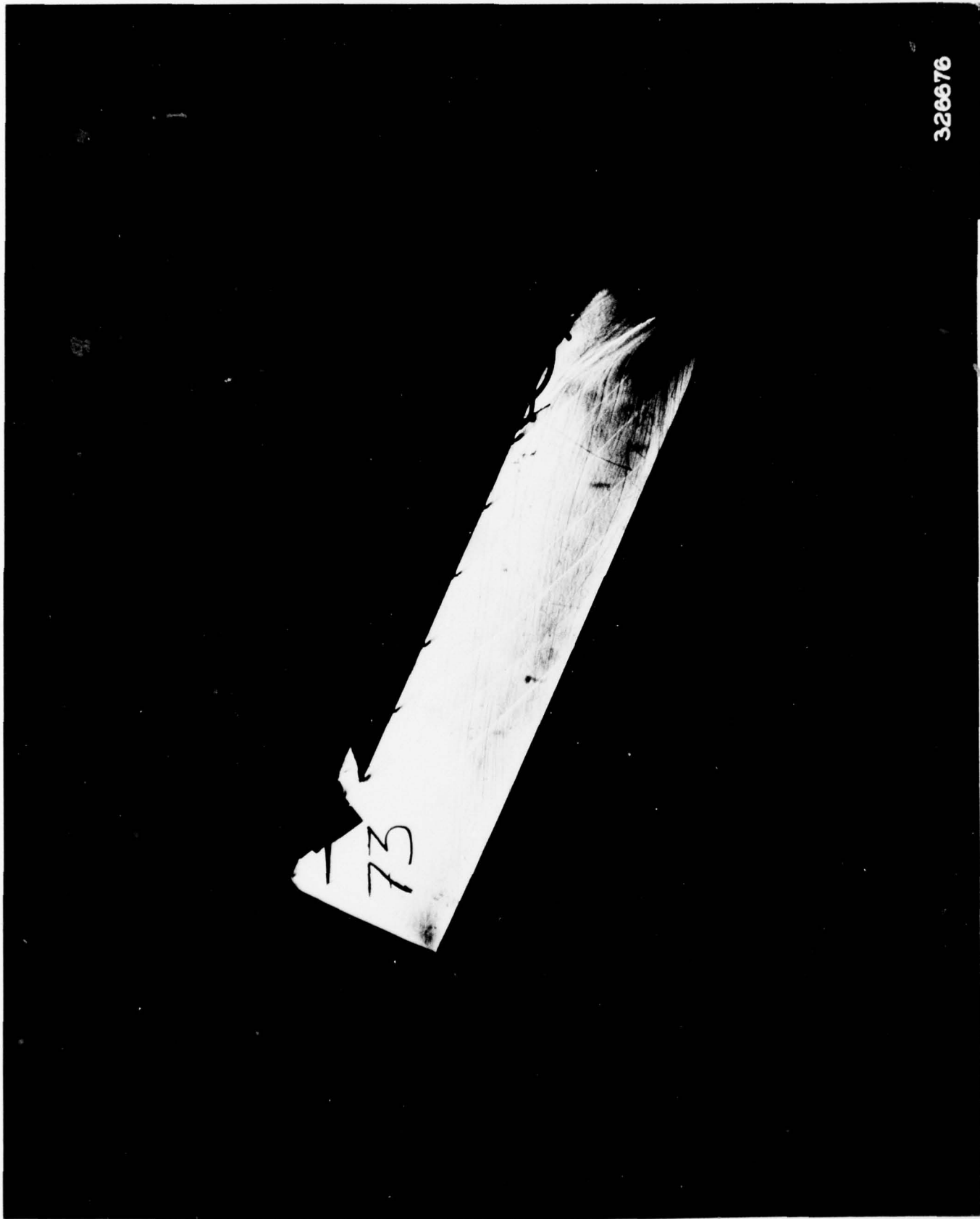
SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.749



03/03/77

82531



326676

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.749

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.731	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ.) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.875	1.504	57.970	24.294	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.141	43.072	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

IAL (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	19.712	19.702	19.699	19.711
	11	18.162	8.556	9.387	1.698
	13	11.290	8.599	10.344	5.289
	15	11.569	9.661	11.710	5.540
	17	11.462	14.539	10.804	5.897
	19	11.438	11.224	9.522	6.873
	21	19.652	10.418	9.146	7.790
	23	9.744	14.540	9.965	8.643
	25	9.852	10.404	11.611	8.807
	27	10.173	8.460	11.948	9.236
	29	10.099	10.115	10.683	9.838
	31	9.882	14.552	9.958	10.699
	33	10.185	10.085	9.949	1.988
	35	9.806	10.852	9.943	2.753
	37	9.805	9.983	9.942	1.577
	39	9.985	14.535	10.000	1.594
	41	10.374	10.747	9.994	1.751
	43	19.664	14.544	11.536	8.755
	45	4.895	10.654	12.168	3.037
	47	19.686	19.666	19.686	5.423

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	52%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.024	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.684	563.838	8.887	65.706

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.683	563.838	66.850	5.671	.238	8.474
ISS	IML	MN)Y,1	MN)Y,1	TT/TT1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.471	1.410

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.744	33	10.185
25	9.852	35	9.896
27	10.173	37	9.805
29	10.099	39	9.685
31	9.882	41	10.374

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
9.950	.161	10.049	.205	1.037	1.755

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.958
		33	9.949
		35	9.943
		37	9.942
		39	10.000
		41	9.994

MEAN TRAILING EDGE PRESSURE [PSIA] 9.964 RMS DEVIATION .024

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.988 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.753 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.577 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.594 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.424 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.751 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.053 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.314 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.077

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.387	5.289	.438	-.045	.477	.269	13.69	13.45
13	10.344	5.289	.551	-.045	.526	.269	26.98	26.63
15	11.710	5.540	.713	-.015	.595	.281	39.60	39.24
17	10.804	5.897	.606	.027	.549	.300	49.07	48.78
19	9.522	6.873	.455	.142	.484	.349	57.88	57.75
21	9.146	7.790	.410	.250	.465	.396	66.00	66.09
23	9.965	8.643	.507	.351	.506	.439	73.41	73.77
25	11.611	8.807	.701	.370	.590	.447	81.70	82.41
27	11.948	9.236	.741	.421	.607	.469	89.05	89.97
29	12.683	9.838	.592	.492	.543	.500	96.93	97.73
0	9.971	9.971	.507	.507	.507	.507	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CD11	CL11	MC1LE	CP1LE
.378	-.312	.214	-34.436	-.021	.377	.144	38.221

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.536	8.785	.692	.364	.586	.445	95.57	93.37
45	12.168	3.837	.767	-.311	.618	.154	110.63	102.50
47		5.423		-.029		.275		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	NN12 TURN PT1P	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10, A T111
.00	6.284 8.031 19.004	1.102 36.285 11.315	.949 .000 11.673	.561 .657 11.506	19.026 1150.763 11.507	8.886 19.687 -1.465	.967 19.647 19.667	30.565 19.667 563.493
5.00	6.363 8.786 19.015	1.087 35.530 11.445	.920 .029 11.515	.565 .654 11.674	19.020 1138.282 11.538	9.051 19.747 -.710	.967 19.696 19.721	31.320 19.722 563.838
9.00	6.442 9.906 18.741	1.075 34.410 11.481	.907 .028 11.384	.576 .933 11.589	18.750 1127.265 11.371	9.061 19.728 .410	.953 19.594 19.661	32.440 19.661 563.838
14.00	6.521 11.247 17.880	.895 33.069 11.438	.744 .027 11.100	.497 1.803 11.463	17.880 966.823 11.227	10.633 19.742 1.751	.908 19.701 19.721	33.781 19.722 563.838
19.00	6.600 12.028 16.400	.802 32.288 11.242	.660 .025 10.844	.455 3.283 11.191	16.400 878.650 10.946	10.737 19.691 2.532	.833 19.664 19.677	34.562 19.678 563.838
24.00	6.679 10.920 13.888	.616 33.306 11.018	.514 .020 10.885	.340 5.795 10.844	13.888 691.155 10.654	10.752 19.686 1.424	.706 19.643 19.664	33.454 19.664 563.838
29.00	6.758 -.437 12.442	.467 44.753 10.730	.433 .016 11.237	.176 7.242 10.641	12.442 532.217 10.497	10.714 19.737 -9.933	.632 19.678 19.707	22.007 19.707 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

12 A 1	PERCT	Y DEV PT)YR	MN)2 TURN P)TR	MN)X,2 M)2 P)RP	MN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 TT)1
65 67 93	35.04	6.836 -4.244 13.348	.563 48.568 10.557	.535 .017 11.513	.177 6.335 10.568	13.348 635.532 10.475	10.764 19.740 -13.740	.678 19.687 19.713	18.290 19.713 563.838
20 22 38	40.04	6.917 -2.772 14.779	.588 47.888 10.482	.547 .023 11.815	.233 4.904 10.545	14.779 765.366 10.653	10.769 19.723 -12.263	.751 19.666 19.694	19.762 19.695 563.838
40 61 38	45.04	6.996 -1.742 16.219	.789 45.858 10.389	.732 .024 11.937	.293 3.464 10.699	16.219 865.608 10.984	10.760 19.695 -10.238	.824 19.659 19.677	21.792 19.677 563.838
81 22 38	50.23	7.075 1.722 17.512	.873 42.594 10.558	.796 .027 11.981	.359 2.171 10.972	17.512 946.953 11.273	10.653 19.731 -7.774	.890 19.676 19.703	24.256 19.703 563.493
62 78 38	55.03	7.154 4.055 18.253	.929 40.261 10.829	.831 .028 11.934	.416 1.430 11.177	18.253 998.653 11.356	10.453 19.754 -5.441	.927 19.697 19.725	26.589 19.725 563.493
54 64 38	60.23	7.233 5.633 18.329	.932 38.683 10.952	.821 .029 11.743	.440 1.354 11.226	18.329 1001.136 11.341	10.465 19.678 -3.863	.931 19.634 19.655	28.167 19.655 563.493
97 97 38	65.02	7.312 7.407 18.164	.932 36.909 11.013	.808 .028 11.439	.465 1.519 11.155	18.164 1001.447 11.262	10.367 19.695 -2.099	.923 19.664 19.679	29.941 19.682 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YR	MN12 TURN P)TR	MN1X,2 M12 P)BP	MN1Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA1P	PT)2/PT)1 PT)O PT)1	BETA12 PT)O,A TT)1
70.02	7.391 7.648 17.010	.659 36.668 10.945	.743 .027 11.271	.432 2.673 10.877	17.010 933.736 10.998	10.502 19.750 -1.858	.864 19.706 19.728	30.182 19.728 563.838
75.02	7.470 1.471 15.465	.735 42.845 10.655	.671 .024 11.717	.299 4.218 10.667	15.465 812.524 10.785	10.802 19.707 -8.035	.786 19.664 19.685	24.005 19.685 563.493
82.01	7.540 2.842 17.954	.915 41.474 10.647	.827 .026 11.961	.392 1.729 10.957	17.954 985.839 11.198	10.441 19.745 -6.664	.912 19.679 19.713	25.376 19.713 563.838
85.01	7.628 5.113 18.672	1.088 39.203 10.838	.964 .029 11.878	.505 .997 11.208	18.686 1138.483 11.445	8.885 19.723 -4.393	.949 19.677 19.700	27.647 19.700 563.838
90.01	7.707 6.236 18.731	1.053 38.080 11.088	.923 .029 11.847	.807 .949 11.451	18.734 1108.823 11.552	9.294 19.703 -3.270	.952 19.654 19.678	28.770 19.678 563.838
95.00	7.786 7.476 18.643	1.031 38.840 11.231	.893 .029 11.691	.516 1.040 11.469	18.643 1090.022 11.507	9.492 19.675 -2.020	.947 19.644 19.659	30.010 19.659 563.838
100.00	7.865 8.065 18.199	.906 36.251 11.289	.780 .028 11.573	.461 1.484 11.464	18.199 977.344 11.466	10.690 19.710 -1.431	.925 19.672 19.691	30.500 19.691 563.838

62531

176

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

HN12 BETA12 PT12/PT11

.894 27.909 .880

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

HN1X,2 HN1Y,2 PT12 P12 TT12 TT12/TT11 M12/M11

.790 .418 17.320 10.308 563.838 1.160 .999

MIXED EXIT CONDITIONS

HN1Y,2 HN1Y,2 PT12 P12 TT12 TT12/TT11 MN12 BETA12

.723 .416 17.002 10.777 563.838 1.139 .834 29.931

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

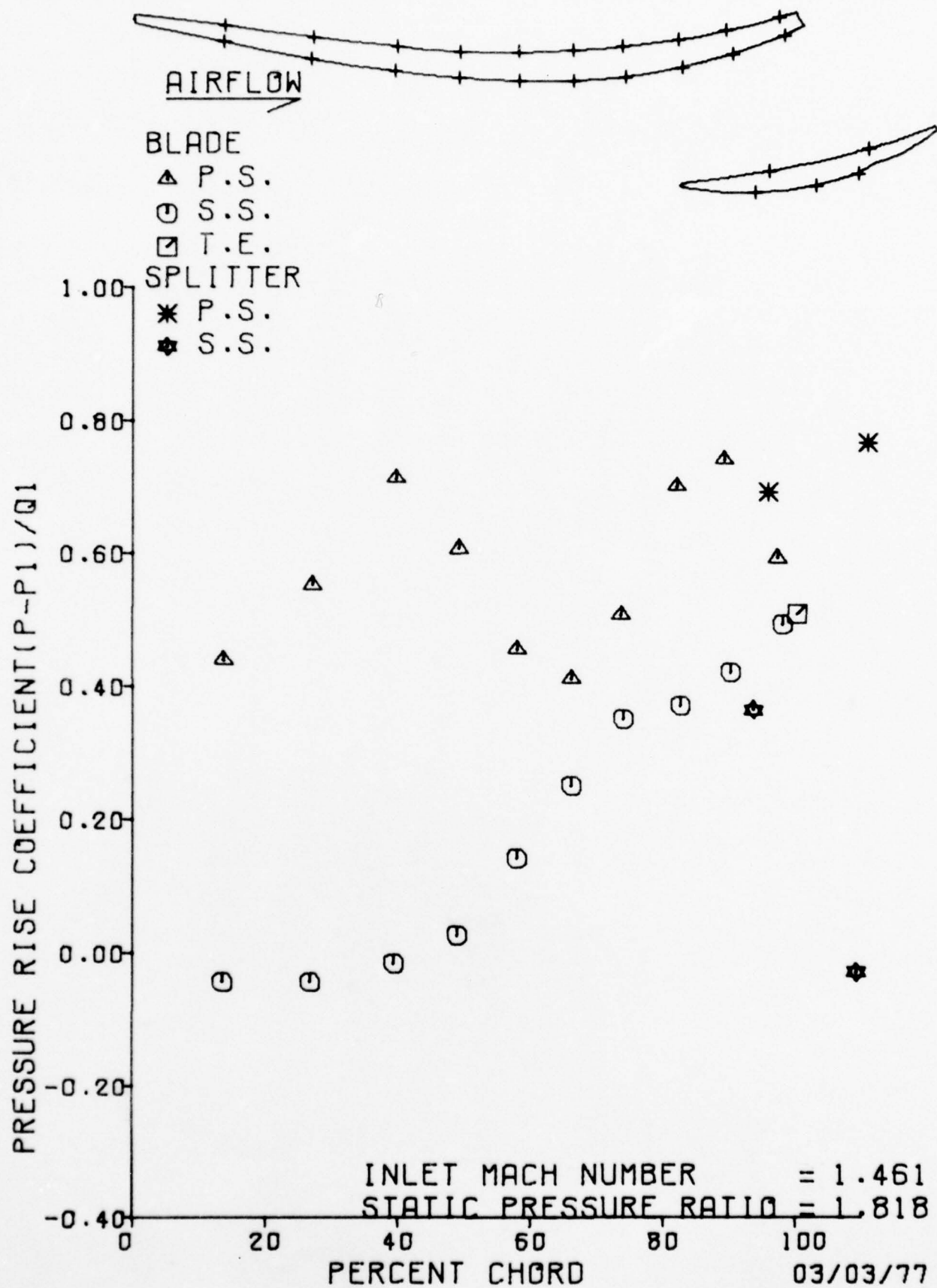
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	OV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.818	.880	.679	1.525	.345	1.478	1.230	.169
.039	.480	1.762	.602	1.210	.547	5.375	38.941
32.955	.444						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

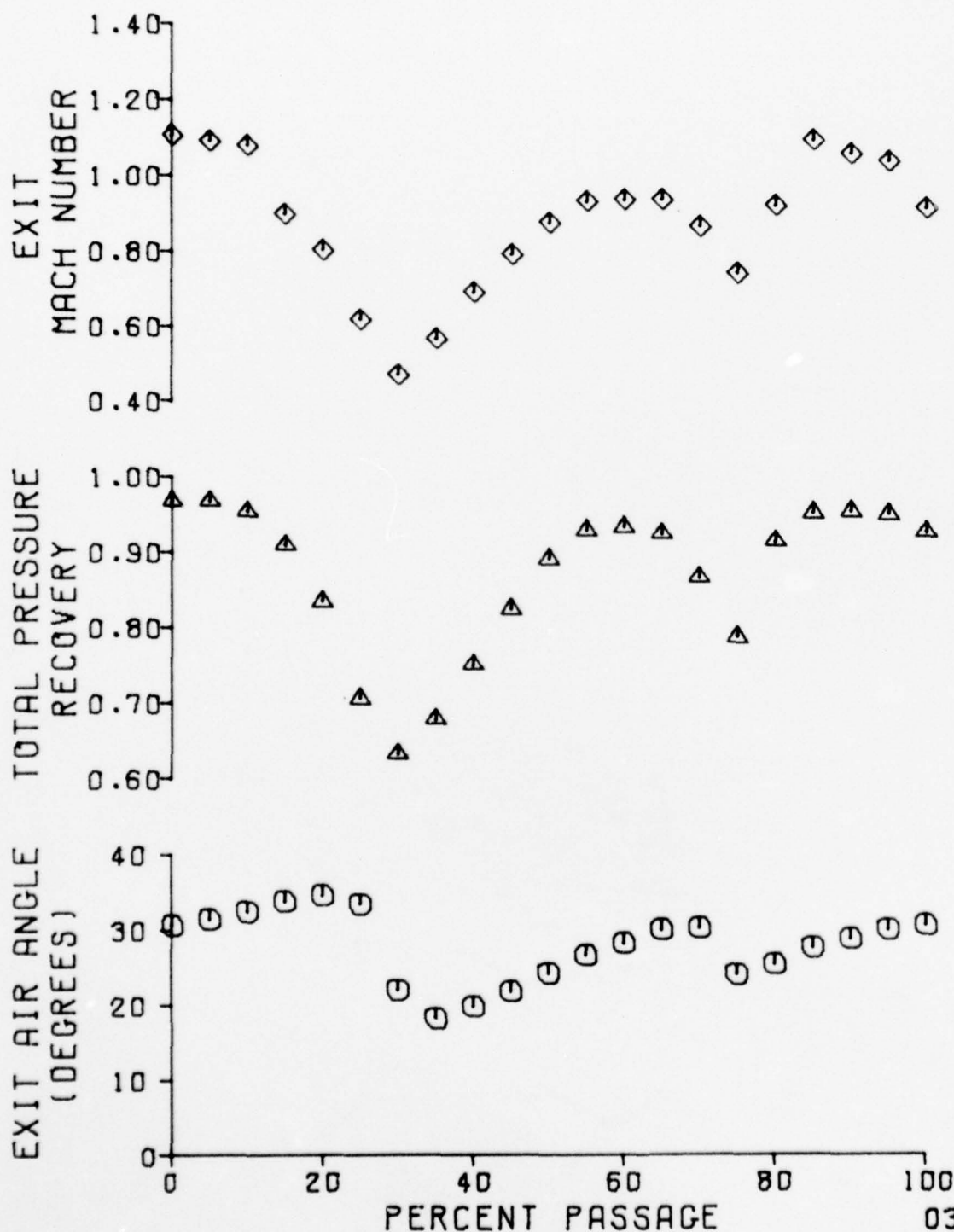
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	OV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.900	.864	.639	1.408	.347	1.517	1.253	.191
.044	.519	1.872	.601	1.154	.603	7.397	36.919
29.781	.468						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

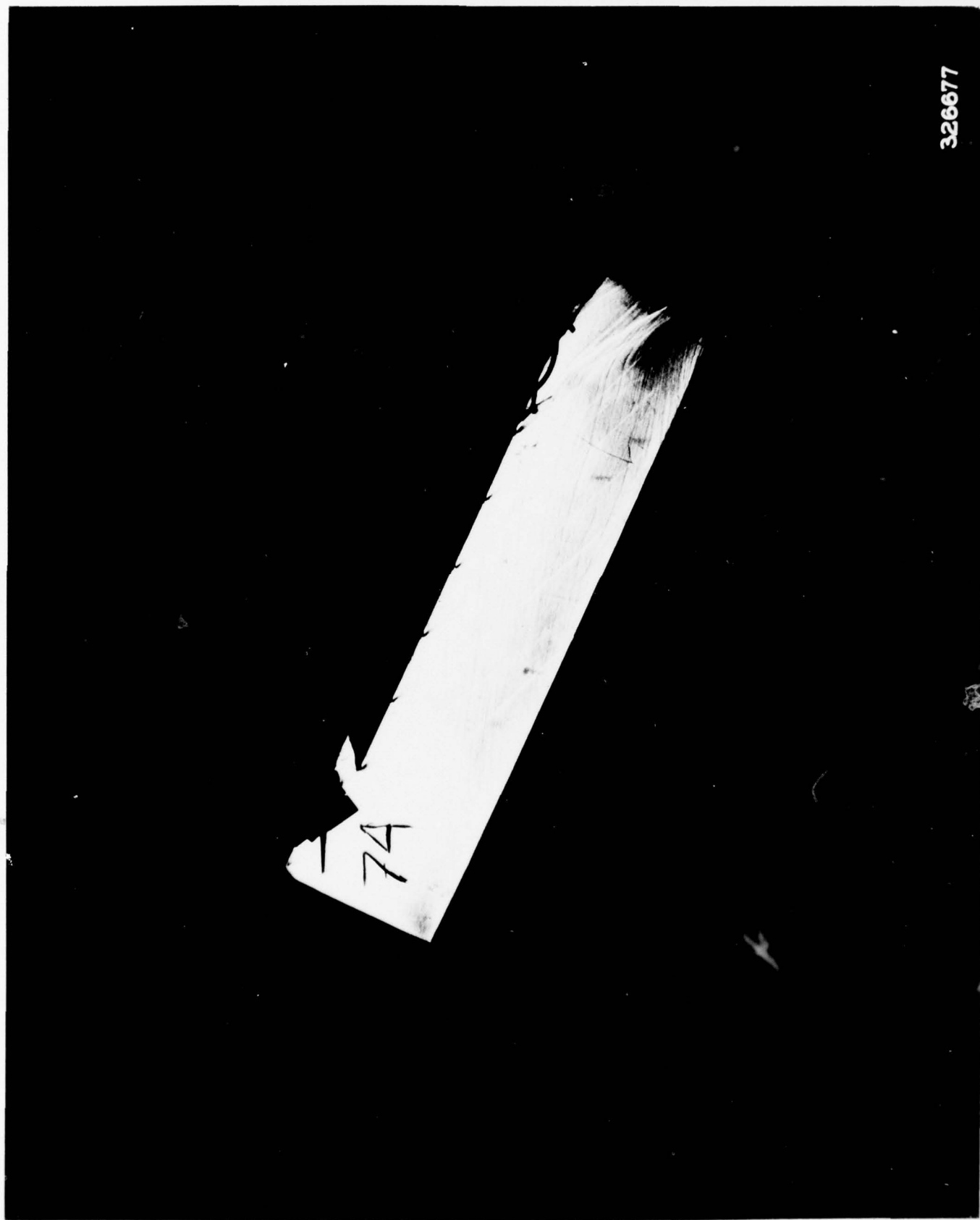


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.818



03/03/77



326677

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.818

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.812	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.873	1.504	57.962	24.290	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.139	43.070	1.461	1.200	1.057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.721	19.726	19.722	19.714
11	18.807	8.547	9.788	1.718
13	11.342	8.915	10.509	5.288
15	11.644	9.753	11.709	5.585
17	11.521	14.544	10.773	6.085
19	11.510	11.284	9.499	7.349
21	19.627	10.403	9.195	8.227
23	9.879	14.545	10.224	8.837
25	9.986	10.404	11.728	8.938
27	10.298	8.574	12.036	9.435
29	10.195	10.244	10.796	10.012
31	10.002	14.555	10.123	19.683
33	10.301	10.278	10.115	2.012
35	10.035	10.956	10.109	2.757
37	9.947	10.118	10.106	1.598
39	10.113	14.540	10.166	1.620
41	10.499	10.853	10.160	1.767
43	19.672	14.546	11.719	8.756
45	4.899	19.661	12.260	3.234
47	19.670	19.675	19.697	5.665

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.780	1.185	.045	52%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN0	PT0	TT0	M0	BETA0
1.500	19.659	563.838	8.876	65.710

CASCADE INLET CONDITIONS

PN1	PT1	TT1	BETA1	P1	M1	Q1
1.461	19.658	563.838	66.850	5.663	.238	8.464
ISS	JML	MN)Y,1	MN)Y,1	TI/T11	PT/P11	NR/10**6
1.371	3.402	.574	1.344	1.427	3.471	1.408

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

ANE1

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.879	33	10.301
25	9.986	35	10.035
27	10.298	37	9.947
29	10.198	39	10.113
31	10.002	41	10.499

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
10.273	.153	10.179	.198	1.026	1.779

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.123
		33	10.115
		35	10.109
		37	10.106
		39	10.166
		41	10.160

MEAN TRAILING EDGE PRESSURE (PSIA) 10.130 RMS DEVIATION .024

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.212 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.787 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.598 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.620 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.424 °F
SIDEWALL BLEED ORIFICE PRESSURE	=	1.767 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.049 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.384 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.074

SUPERSONIC COMPRESSOR CASCADE
ARI STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/D1 (PS)	DPS/D1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.788	5.288	.487	-.244	.498	.269	13.69	13.45
13	10.509	5.288	.573	-.044	.535	.269	26.98	26.63
15	11.729	5.585	.714	-.009	.596	.284	39.60	39.24
17	10.773	6.085	.504	.050	.548	.310	49.07	48.78
19	9.409	7.349	.453	.199	.483	.374	57.88	57.75
21	9.195	8.027	.417	.279	.468	.408	66.00	66.09
23	10.224	8.637	.539	.375	.520	.450	73.41	73.77
25	11.728	8.938	.717	.387	.597	.455	81.70	82.41
27	12.036	9.435	.753	.446	.612	.480	89.05	89.97
29	10.796	10.010	.606	.514	.549	.509	96.93	97.73
30	10.136	10.136	.528	.528	.516	.516	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CD11	CL11	MC1LE	CP1LE
.379	-.313	.213	-34.164	-.023	.378	.140	37.029

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/D1 (PS)	DPS/D1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.719	8.756	.716	.365	.596	.445	95.57	93.37
45	12.260	3.034	.780	-.311	.624	.154	110.63	102.50
47		5.665		.000		.288		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.20	6.284 8.112 19.014	1.099 36.204 11.354	.946 .000 11.724	.560 .624 11.544	19.034 1148.344 11.548	8.921 19.677 -1.394	.968 19.625 19.651	30.646 19.651 563.493
5.00	6.363 8.821 18.806	1.053 35.495 11.491	.899 .029 11.649	.548 .759 11.695	18.899 1108.823 11.548	9.376 19.696 -.675	.961 19.638 19.666	31.355 19.667 563.838
9.99	6.442 9.868 18.477	.916 34.448 11.537	.773 .028 11.463	.491 1.182 11.666	18.477 986.637 11.468	10.735 19.739 .362	.940 19.696 19.717	32.402 19.717 563.838
14.99	6.521 10.941 17.574	.853 33.375 11.427	.720 .026 11.165	.476 2.085 11.488	17.574 937.294 11.275	10.807 19.705 1.435	.894 19.662 19.683	33.475 19.683 563.493
19.99	6.600 11.614 16.242	.780 32.702 11.278	.645 .024 10.960	.438 3.417 11.267	16.242 856.972 11.038	10.869 19.654 2.108	.826 19.590 19.626	34.148 19.627 563.838
24.98	6.679 10.749 14.011	.614 33.567 11.104	.513 .020 10.987	.337 5.648 10.966	14.011 689.269 10.789	10.863 19.684 1.253	.713 19.644 19.663	33.283 19.664 563.838
29.98	6.758 -1.506 12.531	.458 44.822 10.870	.425 .016 11.365	.172 7.128 10.794	12.531 522.293 10.626	10.852 19.694 -10.012	.637 19.639 19.666	22.028 19.666 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

BETA)2 PT)0,A TT)1	PERCT	Y DEV PT)YP	PN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)C BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)0,A TT)1
12.646 19.651 53.493	35.24	6.838 -3.823 13.343	.554 48.139 18.648	.524 .816 11.643	.178 6.315 10.652	13.343 625.491 10.557	10.835 19.682 -13.329	.679 19.631 19.656	18.711 19.657 563.838
11.355 19.667 53.838	40.24	6.917 -2.720 14.715	.672 47.836 10.521	.532 .820 11.878	.228 4.943 10.659	14.715 748.744 10.755	10.876 19.681 -12.226	.749 19.625 19.653	19.814 19.653 564.183
12.402 19.717 53.838	45.24	6.996 -.635 16.236	.775 44.951 18.540	.719 .824 12.842	.289 3.422 10.828	16.236 852.677 11.103	10.912 19.742 -10.141	.826 19.697 19.719	21.809 19.720 563.838
13.475 19.683 53.493	50.23	7.075 1.614 17.451	.859 42.702 18.658	.784 .827 12.873	.352 2.207 11.850	17.451 933.772 11.334	10.774 19.695 -7.892	.888 19.639 19.666	24.148 19.667 563.838
14.148 19.627 53.838	55.23	7.154 3.970 18.157	.906 40.346 18.861	.811 .828 11.955	.404 1.502 11.208	18.157 977.344 11.411	10.566 19.670 -5.536	.924 19.636 19.653	26.524 19.653 563.838
13.283 19.664 53.838	60.23	7.233 5.652 18.342	.928 38.664 11.838	.818 .829 11.925	.436 1.317 11.209	18.342 997.293 11.421	10.521 19.693 -3.854	.933 19.646 19.669	28.186 19.670 564.183
12.028 19.666 53.838	65.22	7.312 7.353 18.114	.917 36.963 11.885	.795 .828 11.515	.457 1.544 11.246	18.114 987.085 11.359	10.519 19.730 -2.153	.921 19.680 19.704	29.887 19.705 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MX2 TURN PTP	MX,Y,2 M)2 P)BP	MY,Y,2 DF)1,2 P)AP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A T)1
72.02	7.391 7.444 16.792	.833 36.872 10.975	.722 .025 11.320	.416 2.866 10.927	16.792 908.982 11.053	10.651 19.675 -2.262	.654 19.630 19.652	29.978 19.652 563.838
75.22	7.472 1.572 15.354	.717 42.744 10.732	.654 .024 11.740	.293 4.304 10.749	15.354 794.199 10.858	10.906 19.677 -7.934	.781 19.631 19.653	24.106 19.654 564.183
80.01	7.549 2.583 17.627	.880 41.753 10.703	.797 .025 11.995	.373 2.032 10.982	17.627 953.297 11.231	10.646 19.707 -6.943	.897 19.648 19.677	25.097 19.678 563.838
85.01	7.628 4.285 18.431	.926 40.032 10.896	.827 .028 11.966	.418 1.228 11.260	18.431 996.232 11.520	10.586 19.719 -5.221	.938 19.675 19.697	26.819 19.697 564.183
90.01	7.707 5.987 18.679	.960 38.329 11.137	.844 .029 11.893	.459 .979 11.454	18.679 1027.080 11.607	10.328 19.703 -3.519	.950 19.638 19.670	28.521 19.670 564.183
95.00	7.786 7.209 18.647	.926 37.107 11.304	.804 .029 11.780	.459 1.012 11.549	18.647 995.750 11.610	10.716 19.700 -2.297	.949 19.680 19.690	29.743 19.690 564.183
100.00	7.865 8.072 18.119	.885 36.244 11.340	.761 .028 11.617	.450 1.539 11.508	18.119 957.417 11.518	10.892 19.687 -1.434	.922 19.634 19.660	30.606 19.660 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.851 27.787 .876

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 M)2/M)1

.752 .397 17.218 10.730 563.838 1.145 .991

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 MN)2 BETA)2

.723 .395 16.917 11.022 563.838 1.130 .807 29.345

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DE)EG	DV)Y	FN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.895	.876	.650	1.462	.330	1.520	1.247	.174
.041	.512	1.843	.617	1.179	.599	5.253	39.063
31.598	.450						

OVERALL PERFORMANCE

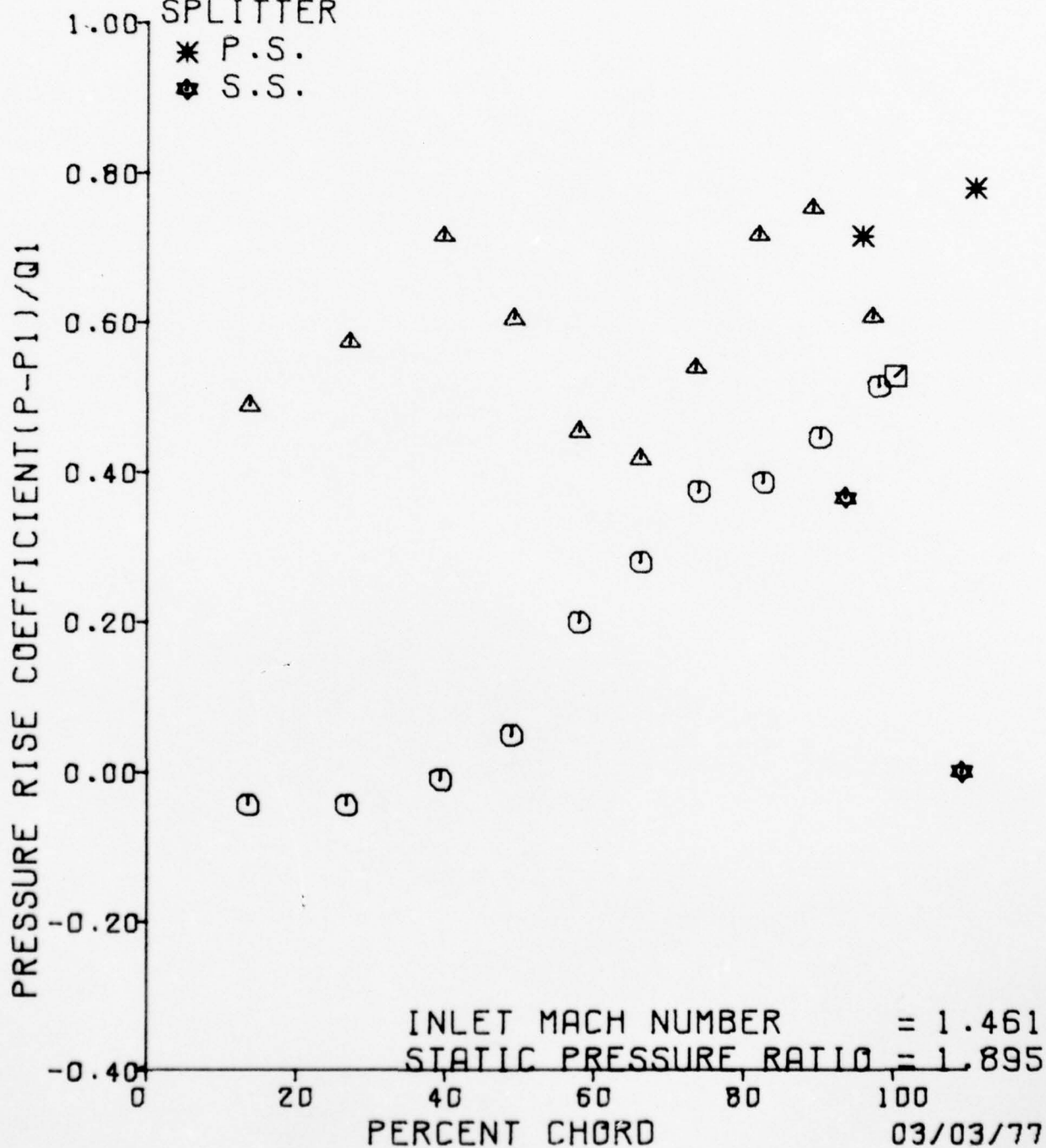
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DE)EG	DV)Y	FN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.946	.861	.621	1.376	.331	1.541	1.263	.196
.045	.541	1.930	.618	1.131	.633	6.811	37.505
28.413	.472						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

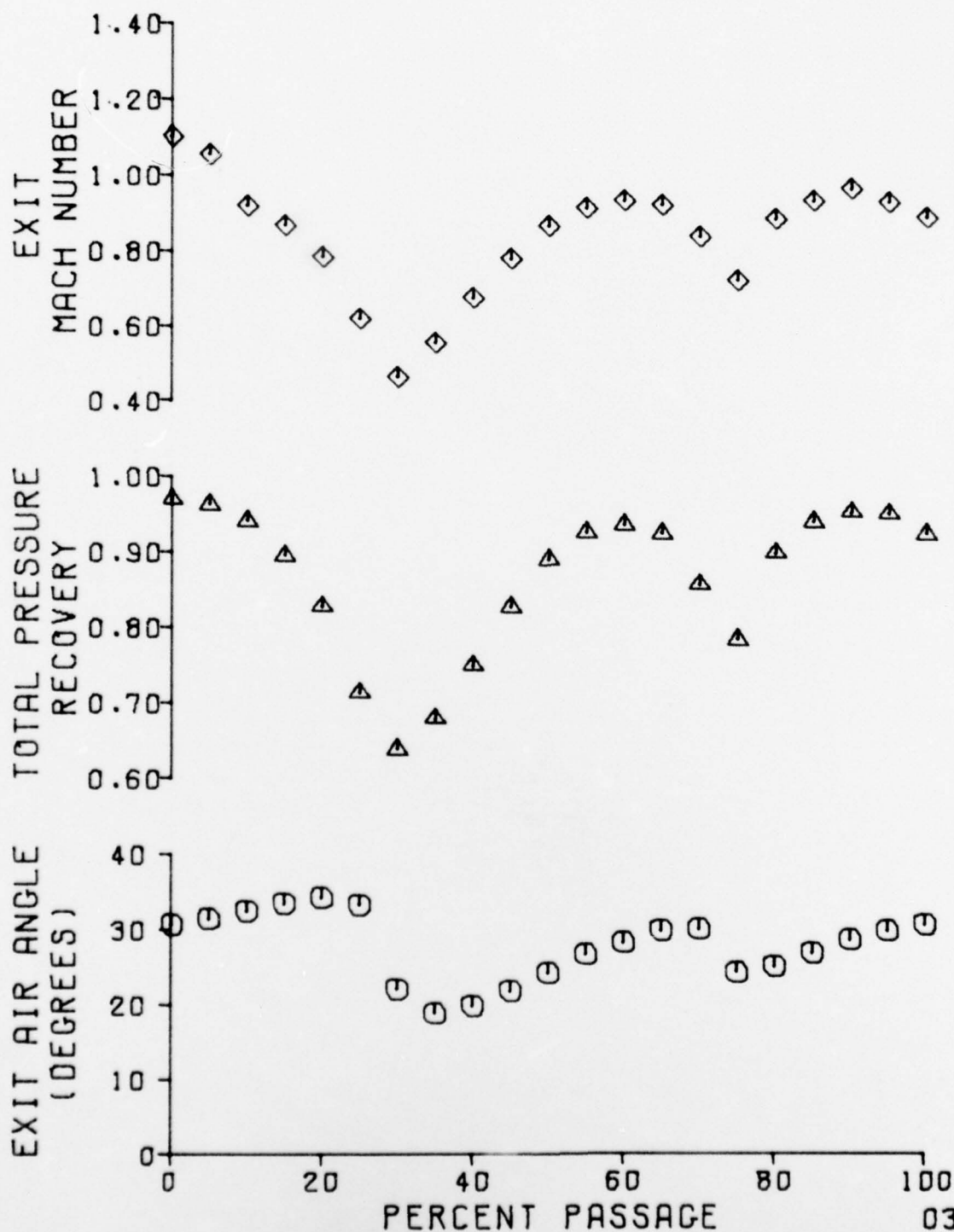


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
 AXIAL PROBE LOCATION, INCHES, = 0.490
 CASCADE INLET MACH NUMBER = 1.461
 CASCADE STATIC PRESSURE RATIO = 1.895



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.859	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.875	1.504	57.970	24.291	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.139	43.070	1.461	1.000	1.057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.674	19.679	19.678	19.700
11	18.116	6.347	10.164	1.696
13	11.412	9.232	10.695	5.296
15	11.713	9.853	11.685	5.620
17	11.588	14.541	10.745	6.341
19	11.626	11.366	9.483	7.247
21	19.612	10.410	9.277	8.334
23	10.863	14.543	10.573	9.072
25	10.177	10.425	11.905	9.109
27	10.450	8.583	12.181	9.668
29	10.384	10.445	10.990	10.243
31	10.193	14.551	10.342	19.700
33	10.499	10.532	10.334	1.981
35	10.235	11.132	10.333	2.798
37	10.154	10.312	10.333	1.590
39	10.311	14.539	10.402	1.605
41	10.605	11.028	10.398	1.742
43	10.576	14.544	11.888	8.776
45	4.927	19.768	12.413	3.034
47	19.690	19.673	19.678	5.880

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION (IN)
39.750	1.185	.045	52%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.204	1.581	.936	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	NL	FL	
(DEGREES)			(DEG.)	
61.417	58.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.520	19.659	563.838	8.876	55.789

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.658	563.838	66.880	8.863	.238	8.464
IX)1	IM)1	MN)X,1	MN)Y,1	TI/T)1	PT/P)1	NR/10**6
1.371	3.482	.574	1.344	1.427	3.471	1.408

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.063	33	10.499
25	10.177	35	10.235
27	10.460	37	10.154
29	10.364	39	10.311
31	10.193	41	10.695

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
10.252	.142	10.379	.195	1.011	1.810

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.342
		33	10.334
		35	10.333
		37	10.333
		39	10.402
		41	10.398

MEAN TRAILING EDGE PRESSURE [PSIA] 10.357 RMS DEVIATION .030

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.981 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.798 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.590 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.605 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.424 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.742 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.046 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.293 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.072

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.164	5.296	.532	-.043	.517	.269	13.69	13.45
13	10.695	5.296	.595	-.043	.544	.269	26.98	26.63
15	11.685	5.620	.712	-.005	.594	.286	39.60	39.24
17	10.745	6.341	.800	.080	.547	.323	49.07	48.78
19	9.483	7.247	.451	.187	.482	.369	57.88	57.75
21	9.277	8.334	.427	.316	.472	.424	66.00	66.29
23	10.573	9.072	.580	.403	.538	.461	73.41	73.77
25	11.905	9.109	.737	.407	.606	.463	81.70	82.41
27	12.181	9.666	.770	.473	.620	.492	89.05	89.97
29	10.990	10.243	.629	.541	.559	.521	96.93	97.73
31	10.368	10.368	.556	.556	.527	.527	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CL11	CL11	MC1LE	CP1LE
.384	-.318	.214	-33.935	-.025	.383	.139	36.249

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.888	8.776	.736	.368	.605	.446	95.57	93.37
45	12.413	3.034	.798	-.311	.631	.154	110.63	102.50
47		5.880		.026		.299		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	KN)2 TURN P)TP	KN)Y,2 M)2 P)BP	KN)Y,2 CP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 TT)1
.00	6.284 8.008 18.931	1.029 36.308 11.460	.887 .000 11.806	.523 .726 11.739	18.932 1288.423 11.621	9.660 19.691 -1.498	.963 19.643 19.667	32.542 19.667 563.838
5.30	6.383 8.733 18.743	.925 35.583 11.561	.790 .029 11.720	.480 .915 11.778	18.743 994.631 11.619	10.786 19.697 -.763	.953 19.642 19.660	31.267 19.669 563.493
9.99	6.442 9.631 18.232	.885 34.685 11.578	.749 .028 11.553	.471 1.426 11.728	18.232 957.417 11.508	10.960 19.721 .125	.927 19.666 19.693	32.165 19.694 563.838
14.99	6.521 10.380 17.262	.827 33.936 11.466	.694 .026 11.315	.440 2.398 11.574	17.260 902.957 11.347	11.018 19.695 .884	.878 19.648 19.671	32.914 19.671 563.838
19.99	6.600 11.078 16.092	.759 33.238 11.335	.632 .024 11.107	.420 3.566 11.358	16.092 836.819 11.165	10.983 19.693 1.582	.819 19.644 19.668	33.612 19.668 563.838
24.98	6.679 10.065 13.970	.593 34.251 11.204	.500 .020 11.155	.320 5.688 11.111	13.970 667.308 10.948	11.011 19.700 .559	.711 19.655 19.677	32.599 19.678 563.838
29.98	6.758 .368 12.667	.455 43.948 11.037	.419 .018 11.486	.177 6.991 10.921	12.667 518.617 10.785	10.992 19.688 -9.138	.644 19.666 19.677	22.902 19.677 563.838

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

Y DEV PT1/P	PERCT	Y DEV PT1/P	MN12 TURN P1/P	MN1Y,2 M12 P1/BP	MN1Y,2 OP11,2 P1/NP	PT12 V12 P1/SP	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10,4 1111
542 667 838	35.24	6.838 -3.425 13.418	.541 47.741 10.810	.512 .016 11.743	.177 6.240 10.815	13.418 612.472 12.755	10.992 19.694 -12.921	.683 19.654 19.673	19.109 19.674 563.838
267 669 493	42.24	6.917 -2.337 14.715	.857 46.653 10.696	.617 .020 11.962	.227 4.943 10.800	14.715 733.791 10.898	11.012 19.676 -11.843	.749 19.628 19.651	20.197 19.652 563.838
165 604 838	45.24	6.996 -5.567 16.134	.758 44.883 10.649	.703 .023 12.088	.283 3.524 10.923	16.134 835.317 11.194	11.028 19.682 -10.063	.821 19.628 19.655	21.967 19.655 563.493
914 671 838	52.23	7.075 1.743 17.409	.842 42.573 10.790	.767 .026 12.147	.346 2.250 11.143	17.409 916.890 11.463	10.948 19.675 -7.763	.886 19.656 19.665	24.277 19.665 563.838
612 668 838	55.23	7.154 3.824 18.154	.885 40.492 11.013	.793 .028 12.106	.393 1.504 11.356	18.154 957.417 11.552	10.913 19.691 -5.672	.923 19.639 19.664	26.358 19.665 563.838
509 678 838	57.23	7.233 5.619 18.307	.906 38.697 11.140	.799 .028 11.913	.427 1.351 11.381	18.307 977.344 11.522	10.754 19.691 -3.877	.931 19.651 19.671	28.153 19.671 563.838
902 677 838	65.22	7.312 7.447 18.053	.906 36.869 11.175	.785 .028 11.578	.453 1.605 11.305	18.053 977.344 11.419	10.604 19.687 -2.049	.918 19.625 19.656	29.081 19.656 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	HN12 TURN P1TP	MN)Y,2 M12 P1BP	MN)Y,2 DP11,2 P1NF	PT)2 V)2 P1SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
72.22	7.391 7.472 16.867	.820 36.844 11.132	.710 .025 11.468	.410 2.791 11.107	16.867 896.463 11.225	10.841 19.712 -2.034	.858 19.682 19.695	30.006 19.696 564.183
75.22	7.472 1.759 15.337	.793 42.547 10.874	.640 .024 11.829	.289 4.351 10.879	15.307 780.252 10.971	11.009 19.712 -7.737	.779 19.657 19.684	24.303 19.684 563.838
80.21	7.549 2.740 17.436	.857 41.576 10.818	.775 .025 12.028	.366 2.220 11.080	17.438 931.160 11.272	10.797 19.703 -6.766	.887 19.669 19.685	25.274 19.686 564.183
85.21	7.628 4.120 18.161	.894 40.196 10.960	.799 .028 12.009	.401 1.497 11.351	18.161 966.417 11.575	10.805 19.698 -5.376	.924 19.643 19.670	26.654 19.671 564.183
90.21	7.727 5.550 18.318	.895 38.766 11.168	.798 .028 11.946	.421 1.340 11.486	18.318 967.406 11.653	10.866 19.695 -3.946	.932 19.649 19.671	28.084 19.672 563.838
95.20	7.786 6.981 18.467	.906 37.415 11.318	.789 .028 11.843	.445 1.191 11.594	18.467 977.344 11.677	10.848 19.660 -2.605	.939 19.647 19.653	29.435 19.653 563.838
100.20	7.865 7.790 18.173	.879 36.526 11.432	.759 .028 11.763	.444 1.485 11.605	18.173 952.149 11.641	10.991 19.707 -1.706	.924 19.660 19.683	30.324 19.683 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.821 27.712 .870

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.727	.382	17.109	10.994	563.838	1.135	.980

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.686	.381	16.833	11.210	563.838	1.123	.785	29.039

2

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

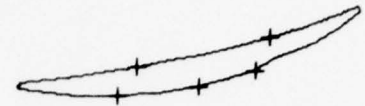
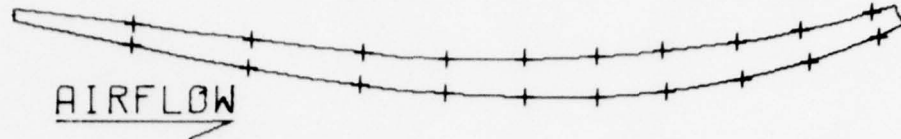
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.941	.872	.630	1.418	.319	1.544	1.258	.182
.242	.535	1.904	.627	1.153	.630	5.178	39.138
38.285	.457						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.982	.856	.605	1.346	.320	1.558	1.271	.202
.246	.589	1.981	.626	1.110	.655	6.505	37.811
26.874	.477						

ARL STREAMLINE NO.10 -- 3 TO 1 STAGE



BLADE

△ P.S.

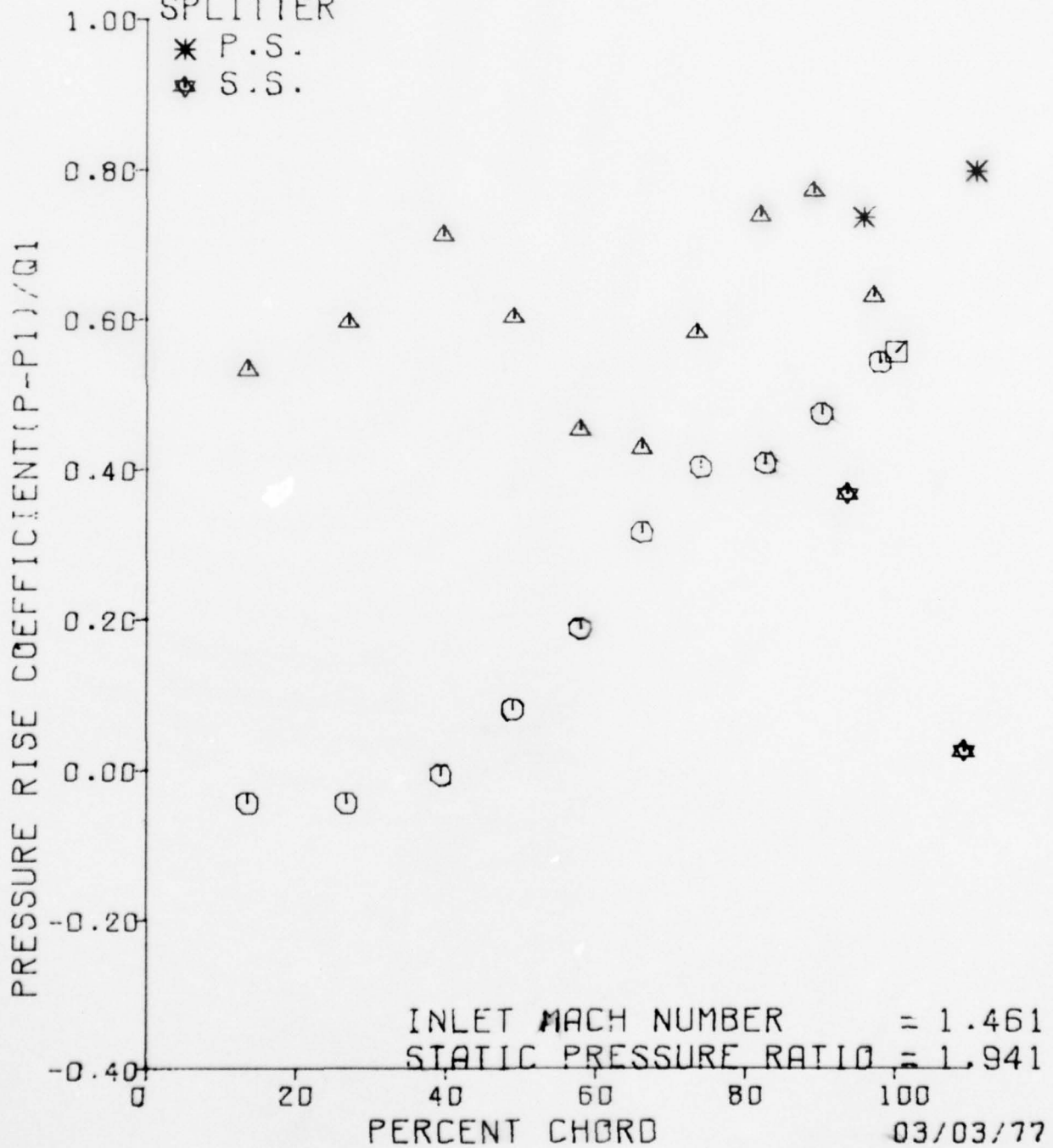
○ S.S.

□ T.E.

SPLITTER

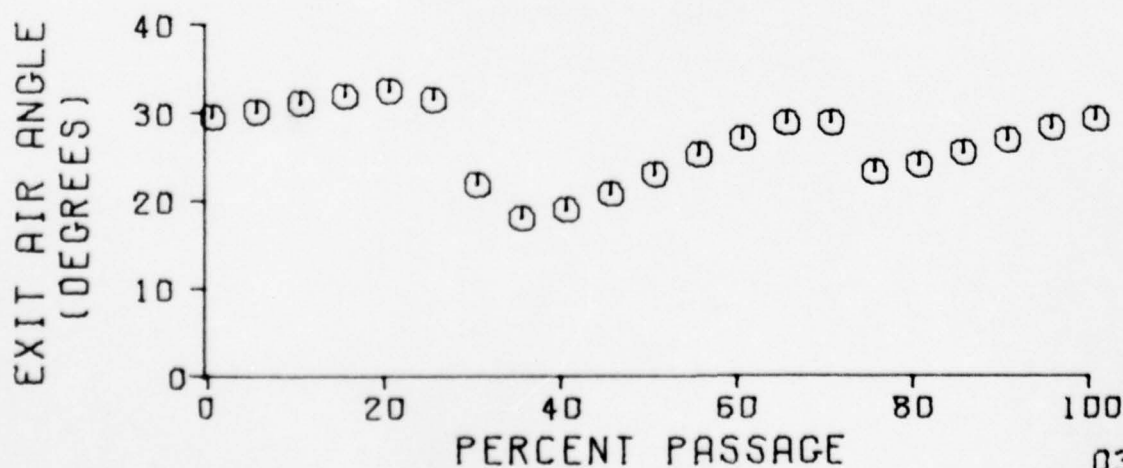
* P.S.

☆ S.S.



SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
 AXIAL PROBE LOCATION, INCHES, = 0.490
 CASCADE INLET MACH NUMBER = 1.461
 CASCADE STATIC PRESSURE RATIO = 1.941



03/03/77

328678



CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.941

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.859	4	.492

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.873	1.504	57.960	24.287	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.136	43.066	1.461	1.000	1.057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.718	19.696	19.697	19.716
11	18.228	6.549	19.578	1.716
13	11.529	9.886	12.852	5.364
15	11.937	10.164	11.667	5.719
17	11.785	14.539	12.687	6.876
19	11.884	11.459	9.427	8.005
21	19.651	12.447	9.579	8.851
23	12.394	14.540	11.186	9.435
25	12.480	12.446	12.184	9.467
27	12.724	8.948	12.403	10.076
29	12.631	12.762	11.285	10.623
31	12.480	14.552	12.698	19.723
33	12.791	12.945	12.690	2.017
35	12.561	11.406	12.667	2.844
37	12.458	12.691	12.676	1.614
39	12.502	14.538	12.762	1.628
41	12.963	11.279	12.754	1.768
43	12.664	14.544	12.071	8.760
45	4.891	12.661	12.608	3.020
47	12.688	12.669	12.686	6.438

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	1/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	52%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.404	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.520	19.686	563.838	8.889	65.713

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.686	563.838	66.850	5.670	.238	8.475
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.575	1.344	1.427	3.472	1.410

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.394	33	10.791
25	10.480	35	10.561
27	10.724	37	10.458
29	10.631	39	10.602
31	10.480	41	10.963

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MTD-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
12.542	.119	10.675	.180	.988	1.859

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.696
		33	10.690
		35	10.687
		37	10.676
		39	10.762
		41	10.754

MEAN TRAILING EDGE PRESSURE (PSIA) 10.711 RMS DEVIATION .034

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.817 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.844 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.614 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.628 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.114 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.768 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.252 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.312 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.075

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.578	5.364	.579	-.036	.537	.272	13.69	13.45
13	10.852	5.364	.611	-.036	.551	.272	28.98	26.63
15	11.667	5.719	.708	.006	.593	.291	39.60	39.24
17	10.687	6.876	.592	.142	.543	.349	49.07	48.78
19	9.427	8.005	.443	.276	.479	.407	57.88	57.75
21	9.579	8.851	.461	.375	.487	.450	66.00	66.09
23	11.186	9.435	.651	.444	.568	.479	73.41	73.77
25	12.184	9.467	.769	.448	.619	.481	81.70	82.41
27	12.403	10.078	.794	.520	.630	.512	89.05	89.97
29	11.285	10.623	.663	.584	.573	.540	96.93	97.73
0	10.719	10.719	.596	.596	.544	.544	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.372	-.310	.226	-33.662	-.026	.371	.129	34.751

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.071	8.760	.755	.365	.613	.445	95.57	93.37
45	12.608	3.020	.819	-.313	.640	.153	110.63	102.50
47		5.438		.091		.327		109.00

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.20	6.284	.895	.775	.448	18.721	11.126	.951	29.909
	7.485	36.851	.000	.965	967.406	19.721	19.665	19.603
	18.721	11.585	11.997	11.913	11.781	-2.241	19.693	563.838
5.00	6.363	.882	.756	.454	18.481	11.138	.939	30.967
	8.433	35.883	.028	1.205	955.189	19.696	19.638	19.667
	18.481	11.653	11.864	11.895	11.721	-1.073	19.667	563.838
9.99	6.442	.845	.720	.443	17.901	11.220	.909	31.596
	9.062	35.254	.027	1.785	919.978	19.650	19.601	19.626
	17.901	11.653	11.734	11.852	11.613	-.444	19.626	564.183
14.99	6.521	.787	.665	.420	17.036	11.316	.865	32.235
	9.701	34.615	.025	2.650	864.395	19.693	19.647	19.670
	17.036	11.587	11.556	11.773	11.543	.195	19.670	563.838
19.99	6.600	.713	.599	.387	15.840	11.283	.805	32.900
	10.366	33.950	.023	3.846	791.046	19.672	19.631	19.651
	15.840	11.462	11.349	11.581	11.398	.860	19.651	563.838
24.98	6.679	.556	.472	.294	13.903	11.271	.706	31.917
	9.383	34.933	.019	5.783	627.853	19.718	19.685	19.702
	13.903	11.401	11.411	11.362	11.237	-.123	19.701	564.183
29.98	6.758	.444	.410	.169	12.867	11.238	.654	22.414
	-.120	44.436	.016	6.819	506.791	19.713	19.673	19.693
	12.867	11.237	11.695	11.181	11.005	-9.626	19.693	563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 C, A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O, A T)1
.999 .603 .838	35.24	6.838 -2.743 13.619	.531 47.959 11.958	.502 .216 11.935	.180 6.267 11.074	13.619 601.257 11.037	11.240 19.684 -12.249	.692 19.628 19.656	19.791 19.655 563.838
.967 .667 .838	40.24	6.917 -1.793 14.852	.540 46.109 10.980	.509 .220 12.162	.227 4.834 11.065	14.852 716.382 11.183	11.272 19.711 -11.299	.754 19.658 19.685	20.741 19.685 564.183
.506 .626 .183	45.24	6.996 -.259 16.135	.735 44.575 10.917	.680 .223 12.260	.279 3.550 11.158	16.135 812.524 11.411	11.270 19.672 -9.765	.820 19.628 19.650	22.275 19.650 564.183
.235 .670 .838	50.23	7.075 1.800 17.342	.812 42.517 11.025	.740 .226 12.317	.335 2.344 11.339	17.342 888.187 11.641	11.243 19.693 -7.717	.881 19.663 19.678	24.334 19.678 564.183
.902 .651 .838	55.23	7.154 3.942 18.152	.863 40.374 11.221	.773 .228 12.267	.385 1.534 11.514	18.152 937.294 11.763	11.163 19.724 -5.574	.922 19.680 19.702	26.476 19.702 564.183
.917 .702 .183	60.23	7.233 5.443 18.271	.875 38.873 11.338	.772 .228 12.117	.410 1.415 11.579	18.271 948.029 11.751	11.101 19.699 -4.063	.926 19.659 19.683	27.977 19.684 563.838
.414 .693 .838	65.22	7.312 7.163 17.989	.863 37.153 11.365	.750 .228 11.801	.428 1.697 11.526	17.989 937.294 11.654	11.063 19.698 -2.343	.914 19.642 19.670	29.697 19.670 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1/P	MN12 TURN P1/P	MN1X,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 T11
72.02	7.391 7.508 16.854	.794 36.808 11.312	.687 .026 11.630	.397 2.832 11.336	16.854 870.700 11.453	11.124 19.634 -1.998	.856 19.591 19.612	30.042 19.612 564.183
75.02	7.470 2.055 15.261	.874 40.260 11.128	.613 .023 11.995	.281 4.424 11.135	15.261 751.604 11.200	11.252 19.711 -7.460	.775 19.666 19.688	24.590 19.688 563.838
80.01	7.549 3.499 17.260	.820 40.817 11.055	.737 .024 12.070	.360 2.426 11.292	17.260 896.463 11.420	11.093 19.708 -6.007	.877 19.644 19.676	26.033 19.676 564.183
85.01	7.628 4.486 17.640	.841 39.910 11.148	.749 .027 12.054	.381 2.046 11.450	17.640 915.787 11.598	11.107 19.690 -5.110	.896 19.648 19.669	26.940 19.669 563.838
90.01	7.707 5.191 17.799	.841 39.125 11.278	.745 .027 12.053	.391 1.886 11.604	17.799 916.539 11.725	11.198 19.737 -4.325	.904 19.701 19.718	27.725 19.719 563.838
95.00	7.786 6.188 18.146	.861 38.128 11.416	.755 .027 12.038	.414 1.540 11.731	18.146 935.317 11.783	11.184 19.707 -3.318	.922 19.654 19.680	28.722 19.681 563.838
100.00	7.865 7.354 18.280	.863 36.962 11.531	.748 .028 11.940	.430 1.406 11.773	18.280 937.294 11.812	11.241 19.727 -2.162	.929 19.657 19.692	29.888 19.692 563.838

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.783 27.578 .862

CASCADE EXIT PARAMETERS
 BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/TT1	M12/M11
.694	.363	15.967	11.313	563.838	1.123	.961

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/TT1	MN12	BETA12
.660	.362	16.723	11.479	563.838	1.113	.753	28.744

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EQ	DV1Y	FN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.995	.862	.624	1.363	.394	1.570	1.271	.194
.045	.564	1.986	.640	1.118	.666	5.044	39.272
27.548	.467						

OVERALL PERFORMANCE

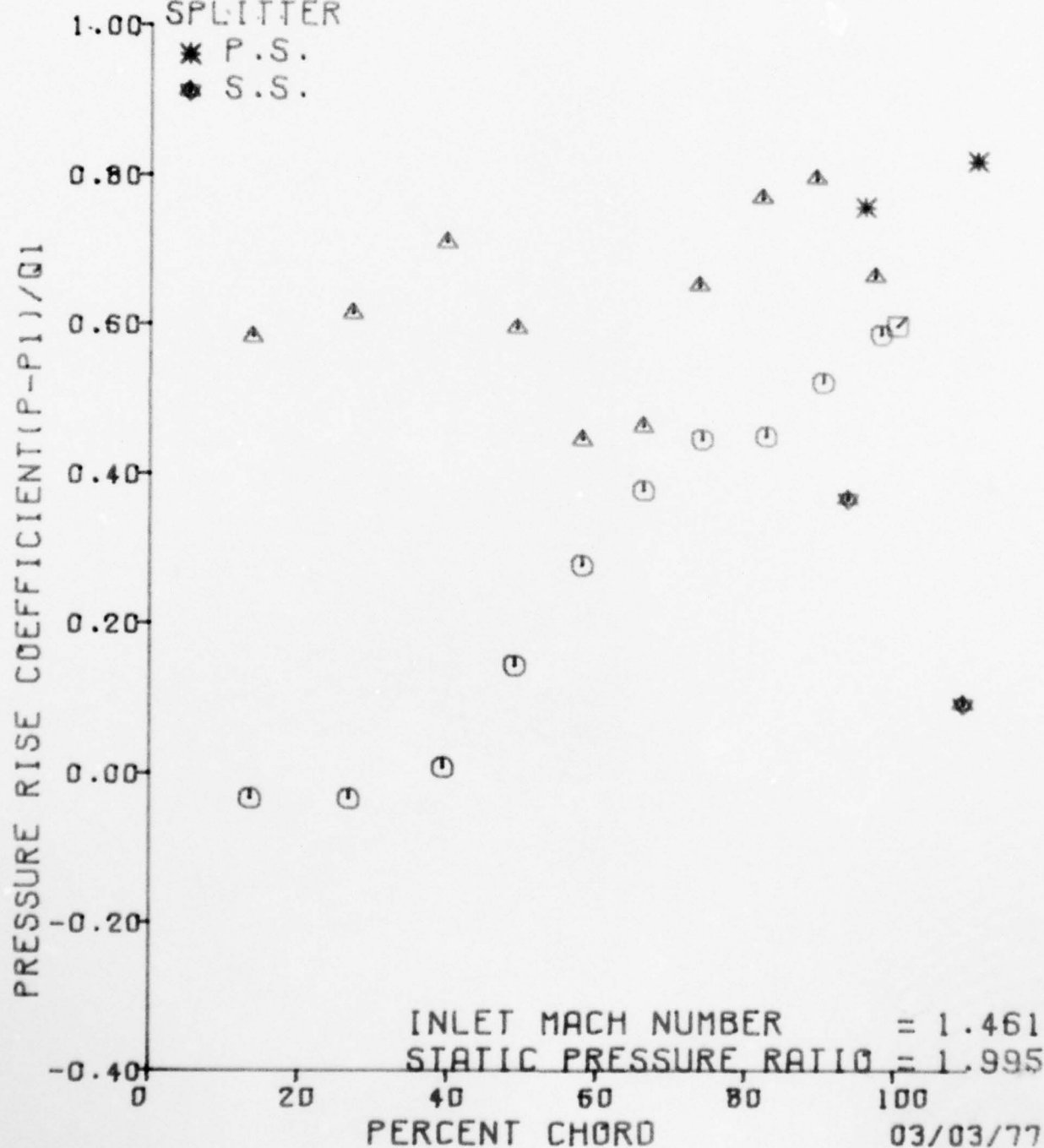
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EQ	DV1Y	FN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
2.025	.849	.584	1.302	.305	1.580	1.282	.211
.049	.585	2.257	.639	1.079	.685	6.210	38.106
24.134	.486						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

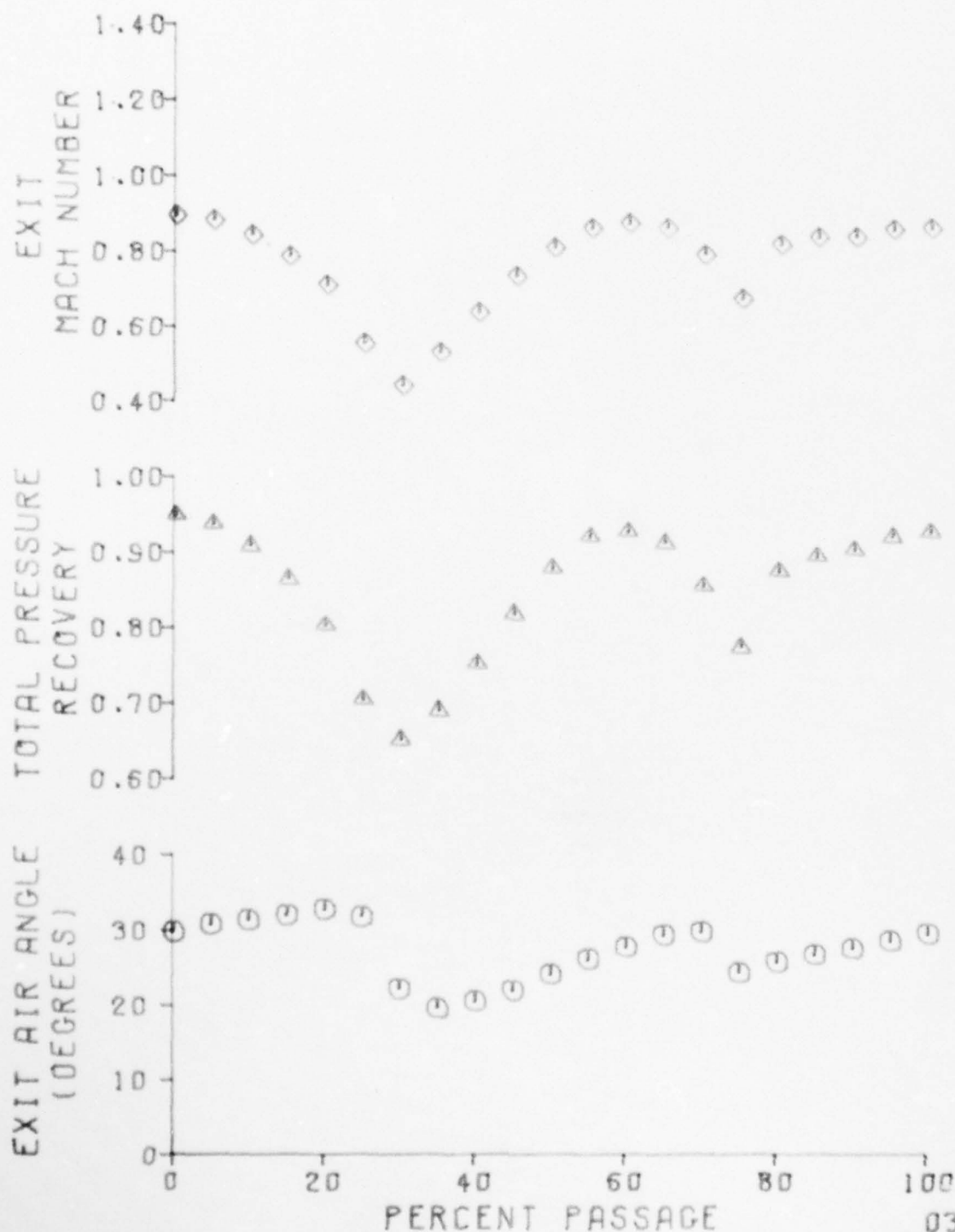


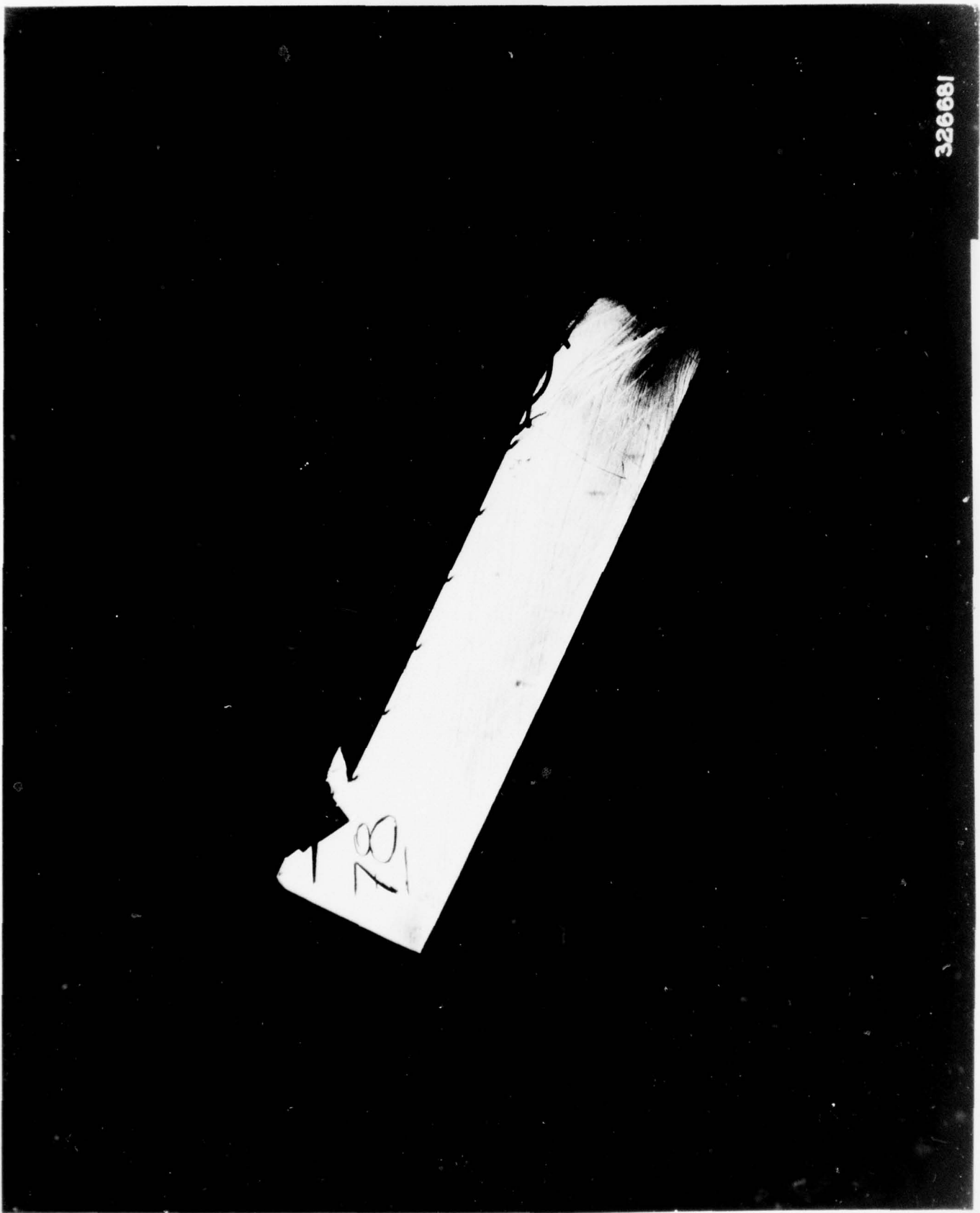
BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 ◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.995





326681

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.995

APPENDIX E

CASCADE DATA

SPLITTER VANE POSITION = 55%

$$P)_2/P)_1 = 1.643$$

$$P)_2/P)_1 = 1.734$$

$$P)_2/P)_1 = 1.794$$

$$P)_2/P)_1 = 1.848$$

$$P)_2/P)_1 = 1.895$$

AD-A043 860

GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER F33615-76-C-2052

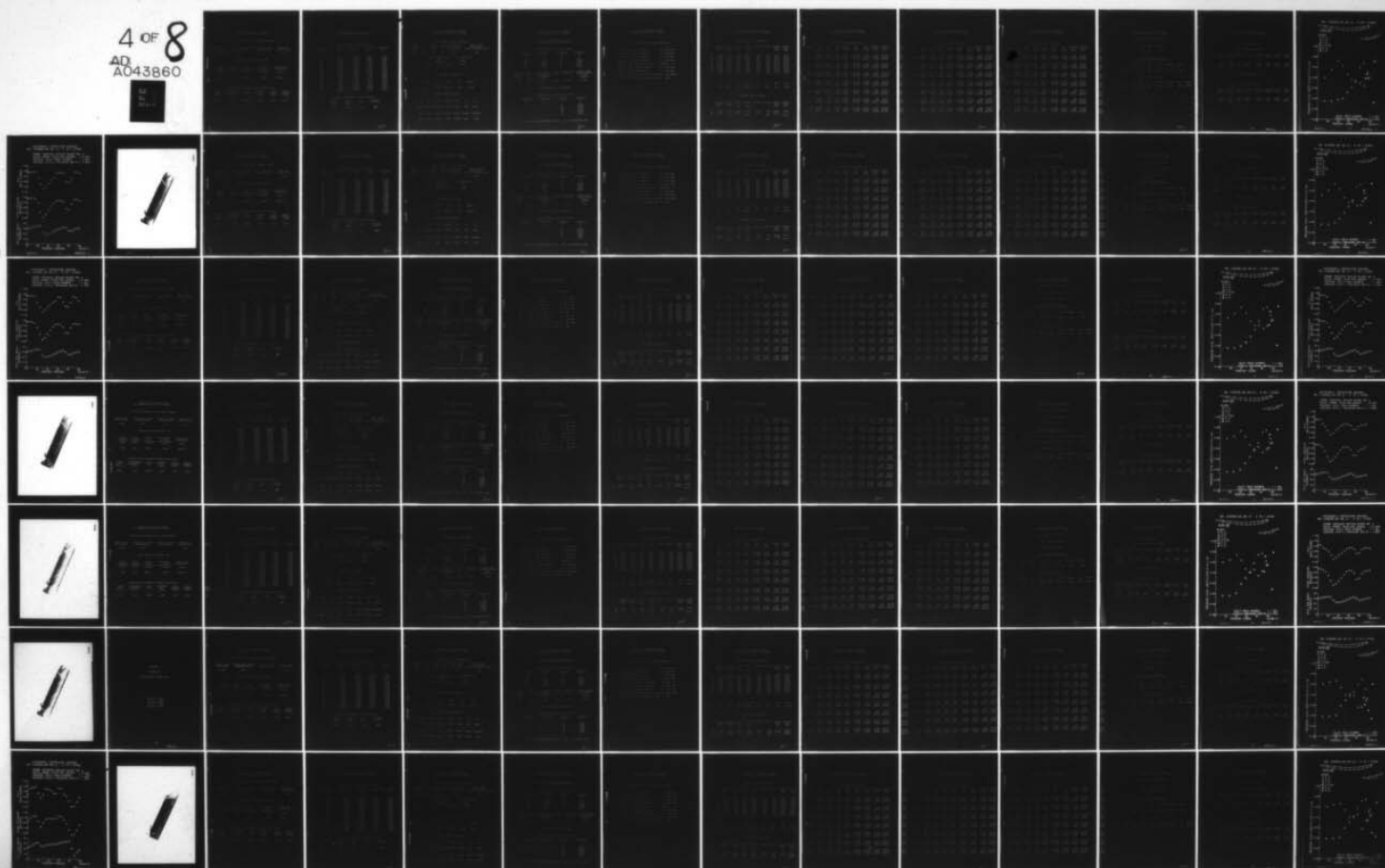
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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 30.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.705	4	.400

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.504	57.970	24.298	562.114

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.148	43.080	1.461	1.000	1.258

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.624	19.622	19.627	19.611
11	18.124	8.511	8.972	1.940
13	18.814	8.358	10.315	5.239
15	11.171	9.544	11.729	5.436
17	11.128	14.469	10.903	5.660
19	10.935	11.176	9.573	6.662
21	19.536	10.373	8.768	7.524
23	9.035	14.470	8.580	8.418
25	9.173	10.373	10.722	8.171
27	9.494	8.335	11.422	7.718
29	9.464	9.177	9.994	8.947
31	9.154	14.482	9.023	19.576
33	9.451	8.922	9.014	2.202
35	9.184	10.248	9.011	2.903
37	9.101	9.202	9.007	1.814
39	9.207	14.467	9.140	1.731
41	9.738	10.136	9.134	1.917
43	19.574	14.474	9.665	8.978
45	4.852	10.582	11.735	2.671
47	19.582	10.569	19.592	5.079

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION (%)
39.750	1.185	.045	55%



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.024	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML		ML
(DEGREES)				(DEG.)
61.417	65.479	63.448		22.534

NOZZLE EXIT CONDITIONS

MM)0	PT)0	TT)0	M)0	BETA)0
1.500	19.574	562.114	8.851	65.702

CASCADE INLET CONDITIONS

MM)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.573	562.114	68.850	5.641	.237	8.427
I)SS	I)ML	MM)X,1	MM)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.470	1.407

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.035	33	9.451
25	9.173	35	9.184
27	9.494	37	9.101
29	9.464	39	9.207
31	9.154	41	9.738

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
9.264	.182	9.336	.232	1.092	1.642

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.023
		33	9.014
		35	9.011
		37	9.007
		39	9.140
		41	9.134

MEAN TRAILING EDGE PRESSURE (PSIA) 9.055 RMS DEVIATION .059

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.202 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.903 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.814 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.731 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	547.976 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.917 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.023 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.222 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.054

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.970	5.239	.395	-.048	.458	.268	13.59	13.45
13	10.315	5.239	.555	-.048	.527	.268	26.98	26.63
15	11.729	5.436	.722	-.024	.599	.278	39.60	39.24
17	10.903	5.660	.624	.002	.557	.289	49.27	48.78
19	9.373	5.682	.467	.124	.489	.341	57.88	57.75
21	8.768	7.524	.371	.224	.448	.384	66.00	66.09
23	8.580	8.418	.349	.330	.438	.430	73.41	73.77
25	10.722	9.171	.603	.300	.548	.417	81.70	82.41
27	11.422	7.718	.686	.246	.584	.394	89.05	89.97
29	9.994	8.947	.517	.392	.511	.457	96.93	97.73
0	9.873	9.873	.407	.407	.464	.464	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CL11	CL11	MC1E	CP1E
.377	-.310	.215	-34.923	-.018	.377	.147	38.894

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	9.665	8.978	.477	.396	.494	.459	95.57	93.37
45	11.735		.723		.600		110.63	
47		5.079		-.067		.259		109.00

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	PN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)AP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.284	1.138	.989	.564	18.919	8.445	.967	29.685
	7.151	37.165	.000	.554	1178.956	18.612	19.559	19.584
	18.869	10.889	11.457	11.238	11.180	-2.345	19.584	562.803
5.00	6.353	1.148	.987	.586	19.121	8.435	.977	30.732
	8.196	35.120	.029	.452	1186.629	19.663	19.652	19.657
	19.060	11.061	11.387	11.283	11.192	-1.312	19.657	562.459
9.99	6.442	1.147	.977	.602	19.103	8.432	.976	31.642
	9.188	35.208	.028	.471	1186.176	19.641	19.588	19.615
	19.043	11.101	11.198	11.278	11.145	-.388	19.614	562.803
14.99	6.521	1.151	.961	.632	18.847	8.283	.963	33.345
	10.811	33.505	.028	.727	1188.990	19.648	19.613	19.631
	18.784	11.088	10.766	11.123	10.949	1.305	19.630	562.803
19.99	6.600	.925	.756	.634	17.181	9.881	.878	35.244
	12.712	31.606	.026	2.392	993.631	19.651	19.651	19.651
	17.181	11.003	10.387	10.798	10.569	3.214	19.650	562.803
24.98	6.679	.686	.585	.388	13.953	10.187	.713	34.499
	11.965	32.351	.022	5.621	761.899	19.624	19.597	19.610
	13.953	10.555	10.285	10.265	10.137	2.469	19.610	562.803
29.98	6.758	.512	.475	.193	12.051	10.275	.616	22.098
	-.436	44.752	.017	7.522	580.436	19.691	19.641	19.666
	12.051	10.054	10.639	9.974	9.873	-9.932	19.665	563.148

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1BP	MN1Y,2 DF11,2 F1NP	PT12 V12 F1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
2 A									
15		6.838	.889	.579	.189	13.021	10.135	.665	18.038
14	35.24	-4.406	48.812	.817	6.552	683.144	19.612	19.592	19.602
13		13.021	9.858	11.250	9.972	9.833	-13.992	19.601	562.803
10		6.917	.721	.682	.233	14.426	10.206	.737	18.840
7	40.24	-3.694	48.810	.221	5.147	797.355	19.618	19.563	19.591
9		14.426	9.746	11.325	10.040	10.031	-13.190	19.590	562.803
12		6.996	.830	.774	.300	15.960	10.159	.815	21.206
15	45.24	-1.328	48.644	.024	3.614	904.257	19.634	19.578	19.606
13		15.960	9.801	11.507	10.270	10.395	-10.824	19.605	562.803
15		7.075	.924	.845	.375	17.300	9.959	.884	23.939
11	50.23	1.425	42.911	.027	2.273	992.776	19.649	19.605	19.627
13		17.300	10.042	11.591	10.582	10.738	-8.091	19.626	562.803
14		7.154	1.110	.990	.502	18.094	8.370	.924	26.891
11	55.23	4.357	39.959	.028	1.480	1155.444	19.638	19.602	19.620
13		18.068	10.336	11.527	10.815	10.923	-5.139	19.619	563.148
9		7.233	1.116	.982	.530	18.208	8.361	.930	28.346
10	60.23	5.612	38.504	.028	1.366	1160.362	19.615	19.576	19.595
13		18.178	10.508	11.373	10.909	10.968	-3.694	19.595	563.148
18		7.312	1.124	.971	.567	18.129	8.238	.926	30.283
16	65.22	7.749	36.567	.028	1.444	1167.258	19.645	19.585	19.615
18		18.093	10.610	11.019	10.841	10.891	-1.747	19.615	562.803

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YF	PN12 TURN P)TP	PN1X,2 M)2 P)RP	PN1Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A T)1
7	7.391 9.752 17.591	1.113 34.564 10.597	.941 .927 10.539	.594 1.956 10.644	17.618 1157.610 10.679	8.123 19.644 .256	.900 19.592 19.618	32.286 19.618 563.148
75.02	7.478 8.713 15.128	.784 35.603 10.385	.670 .924 10.495	.407 4.445 10.249	15.128 959.641 10.238	10.284 19.611 -.783	.773 19.559 19.585	31.247 19.585 563.148
82.01	7.549 2.895 14.701	.744 41.421 10.118	.672 .922 10.961	.319 4.872 10.233	14.701 820.434 10.139	10.180 19.655 -6.501	.751 19.610 19.632	25.429 19.633 563.148
85.01	7.628 2.767 16.889	.895 41.849 10.113	.809 .924 11.336	.383 2.684 10.589	15.889 965.925 10.461	10.037 19.648 -6.729	.863 19.609 19.628	25.301 19.629 563.493
90.01	7.727 5.187 18.435	1.143 39.209 10.349	1.012 .928 11.404	.530 1.085 10.961	18.489 1182.497 10.843	8.208 19.631 -4.389	.945 19.571 19.600	27.641 19.601 563.493
95.00	7.786 7.066 18.652	1.144 37.310 10.685	.995 .928 11.291	.564 .866 11.115	18.708 1183.592 10.973	8.291 19.625 -2.490	.956 19.599 19.611	29.540 19.612 563.493
100.00	7.855 7.922 18.138	1.100 36.394 10.839	.949 .928 11.205	.558 1.416 11.158	18.158 1147.361 10.956	8.501 19.640 -1.574	.928 19.584 19.612	30.456 19.612 563.493

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

HN12 BETA12 PT12/PT11

.977 28.888 .873

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

HN1X,2	HN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.862	.462	17.890	9.270	562.114	1.191	.992

MIXED EXIT CONDITIONS

HN1X,2	HN1Y,2	PT12	P12	TT12	TT12/T12	HN12	BETA12
.762	.455	15.714	10.210	562.114	1.158	.888	30.852

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	DVY	RM2	DPS/D1	DEV	TURN
BETA/C	A2/A1						
1.643	.873	.732	1.643	.375	1.372	1.198	.178
.841	.419	1.629	.575	1.234	.431	5.555	38.761
33.192	.444						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	DVY	RM2	DPS/D1	DEV	TURN
BETA/C	A2/A1						
1.775	.854	.675	1.474	.376	1.440	1.232	.205
.846	.476	1.767	.573	1.169	.518	8.318	35.998
30.031	.471						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

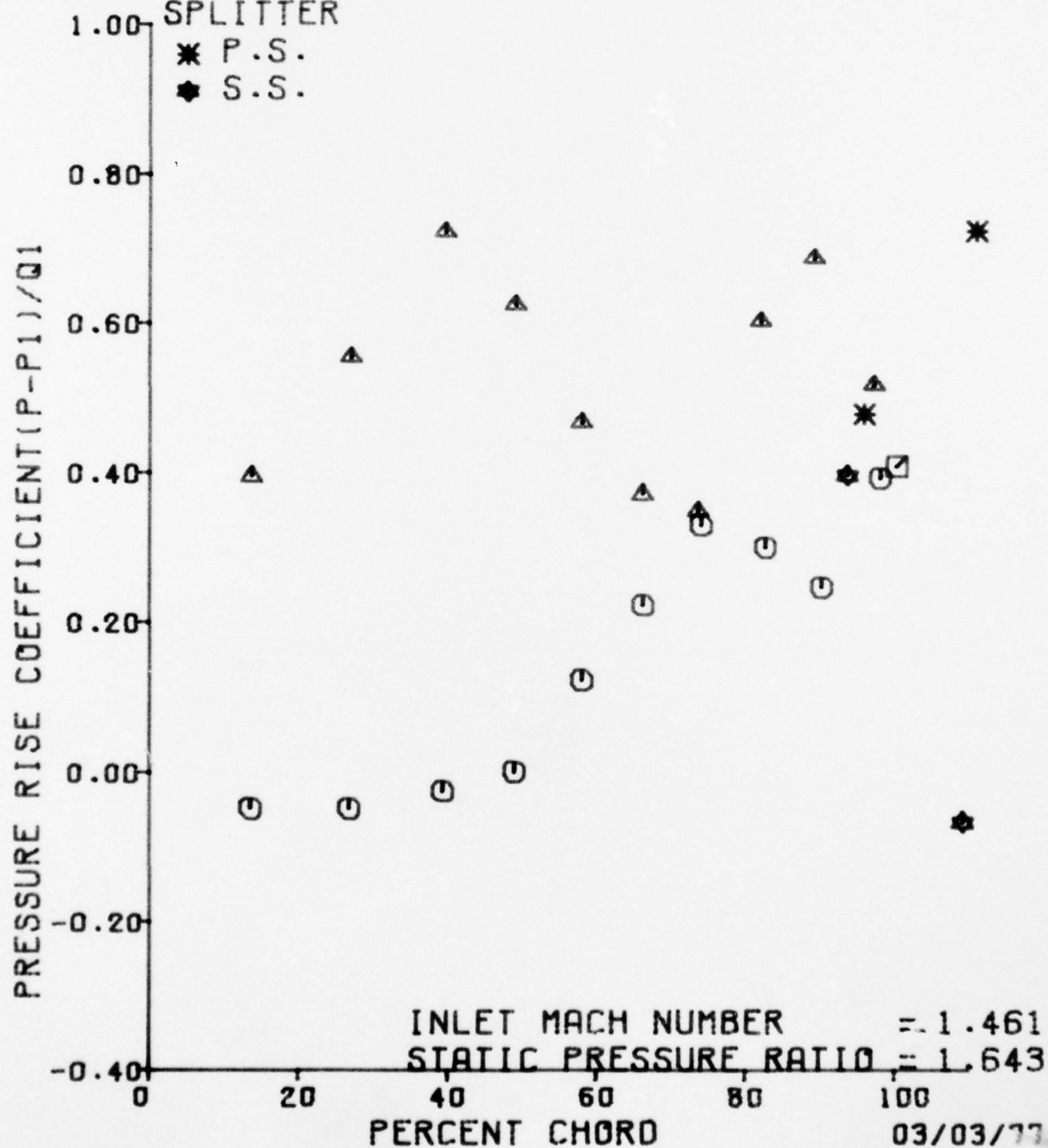
○ S.S.

◻ T.E.

SPLITTER

* P.S.

◆ S.S.



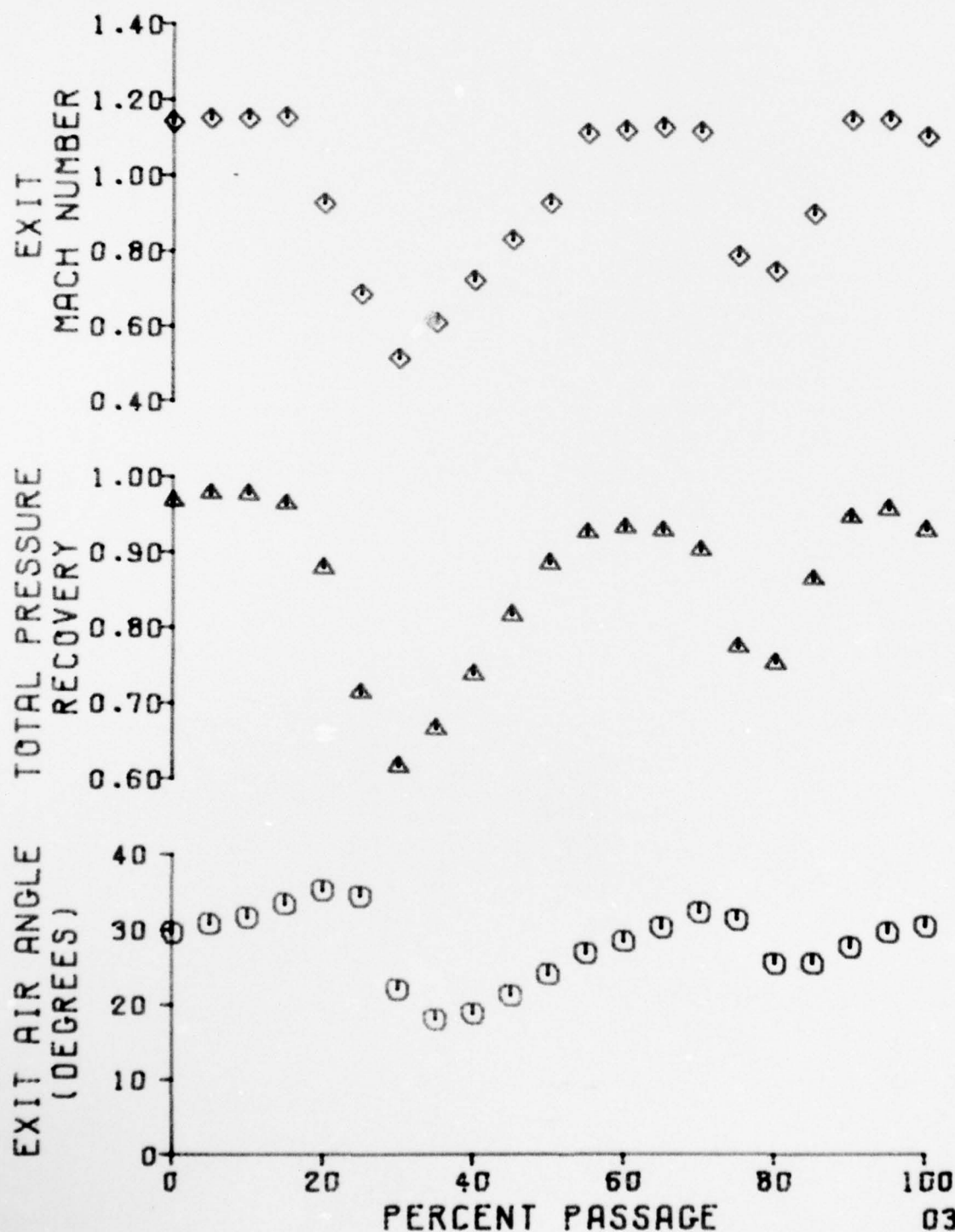
SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4

AXIAL PROBE LOCATION, INCHES, = 0.490

CASCADE INLET MACH NUMBER = 1.461

CASCADE STATIC PRESSURE RATIO = 1.643



03/03/77



326650

CASCADE INLET SCHLIEREN - MN) I = 1.46, P)2/P)1 = 1.643

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.735	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.504	57.970	24.295	564.123

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	* COMPRESSION * EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.146	43.078	1.461	1.000	1.058

62531

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE KC.12 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT 8	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.641	19.659	19.641	19.659
11	18.125	6.523	10.019	1.862
13	10.949	9.136	10.781	5.251
15	11.408	9.785	11.801	5.564
17	11.305	14.471	10.941	6.142
19	11.154	11.376	9.604	7.179
21	19.615	10.433	8.836	8.157
23	9.442	14.472	9.214	8.922
25	9.532	10.425	11.316	8.286
27	9.857	8.244	11.696	8.393
29	9.797	9.625	10.336	9.445
31	9.554	14.482	9.513	19.643
33	9.822	9.450	9.503	2.185
35	9.562	10.563	9.500	2.870
37	9.501	9.597	9.498	1.810
39	9.599	14.468	9.630	1.746
41	10.058	10.445	9.620	1.919
43	19.627	14.476	10.759	9.042
45	4.824	19.590	11.674	2.415
47	19.585	19.607	19.616	5.566

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	55%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAPLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.804	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN10	PT10	TT10	M10	BETA10
1.500	19.614	564.183	8.853	65.725

CASCADE INLET CONDITIONS

PN11	PT11	TT11	BETA11	P11	M11	Q11
1.461	19.613	564.183	66.850	5.652	.237	8.444
I)SS	I)ML	MN1Y,1	MN1Y,1	TI/T11	PT/P11	NR/10**6
1.371	3.402	.574	1.343	1.427	3.470	1.404

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.442	33	9.822
25	9.532	35	9.562
27	9.657	37	9.501
29	9.797	39	9.599
31	9.554	41	10.058

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.635	.161	9.708	.206	1.061	1.705

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.513
		33	9.503
		35	9.500
		37	9.498
		39	9.630
		41	9.620

MEAN TRAILING EDGE PRESSURE (PSIA) 9.544 RMS DEVIATION .057

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAKLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.185 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.870 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.810 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.746 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.424 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.919 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.257 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.340 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.283

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
1	10.019	5.251	.517	-.047	.511	.268	13.69	13.45
3	10.781	5.251	.607	-.047	.550	.268	26.98	26.63
5	11.801	5.564	.728	-.010	.602	.284	39.60	39.24
7	10.941	6.142	.626	.058	.558	.313	49.27	48.78
9	9.624	7.170	.468	.181	.390	.366	57.38	57.75
11	8.836	8.157	.377	.297	.451	.416	66.00	66.09
13	9.214	8.922	.422	.387	.470	.455	73.41	73.77
15	11.316	8.286	.571	.312	.577	.422	81.70	82.41
17	11.696	8.393	.716	.325	.596	.428	89.05	89.97
19	10.336	9.448	.555	.449	.527	.482	96.93	97.73
21	9.564	9.564	.463	.463	.488	.488	100.00	100.00
	FC	FC(Y)	FC(Y)	BETA(F)	CL11	CL11	MC1LE	CP1LE
	.390	-.321	.220	-34.300	-.023	.390	.143	36.576

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	10.759	9.042	.605	.401	.549	.461	95.57	93.37
45	11.874		.737		.625		110.63	
47		5.566		-.010		.284		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MA)2 TURN P)TP	MA)Y,2 M)2 P)BP	MA)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.20	6.284	1.122	.978	.554	18.948	8.629	.966	29.591
	7.857	37.259	.200	.665	1167.971	19.618	19.570	19.594
	18.912	11.021	11.618	11.394	11.308	-2.439	19.594	564.528
5.00	6.363	1.123	.967	.571	19.015	8.653	.970	32.551
	8.017	36.299	.029	.598	1168.525	19.633	19.597	19.615
	18.979	11.167	11.530	11.468	11.337	-1.479	19.615	564.528
9.99	6.442	1.127	.959	.591	18.964	8.592	.967	31.667
	9.133	35.183	.028	.650	1171.323	19.641	19.588	19.614
	18.924	11.230	11.319	11.422	11.278	-1.363	19.614	564.528
14.99	6.521	1.112	.931	.608	18.440	8.509	.940	33.139
	10.608	33.711	.028	1.173	1159.247	19.609	19.598	19.604
	18.413	11.199	10.936	11.268	11.051	1.109	19.603	564.528
20.00	6.600	.863	.709	.492	16.846	10.359	.859	34.728
	12.194	32.152	.026	2.768	937.580	19.596	19.590	19.593
	16.846	11.056	10.583	10.975	10.732	2.698	19.593	564.528
24.98	6.679	.689	.571	.385	14.329	10.433	.731	34.002
	11.468	32.348	.022	5.284	766.470	19.626	19.570	19.598
	14.329	10.767	10.545	10.559	10.380	1.972	19.598	564.528
30.98	6.758	.500	.458	.200	12.300	10.369	.627	23.565
	1.031	43.288	.017	7.313	568.212	19.627	19.587	19.607
	12.300	10.367	10.854	10.314	10.205	-8.475	19.607	564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT1C BETA1)P	PT12/PT11 PT1C PT11	BETA12 PT1C,4 TT11
1 4 8	5.24	6.838 -2.713 13.085	.586 47.229 10.154	.551 .217 11.138	.199 6.529 10.254	13.085 659.840 10.148	10.372 10.519 -12.209	.567 19.564 19.601	19.821 19.601 564.183
1 5 8	11.24	6.917 -2.455 14.313	.589 46.771 10.059	.547 .220 11.398	.236 5.391 10.282	14.313 766.364 10.293	10.422 19.609 -11.951	.730 19.565 19.587	20.079 19.587 564.528
7 4 8	5.24	6.996 -1.880 15.728	.785 45.196 10.296	.730 .223 11.512	.290 3.886 10.460	15.728 862.569 10.614	10.469 19.635 -10.376	.802 19.583 19.609	21.654 19.609 564.528
9 4 8	11.23	7.075 1.198 17.045	.672 43.118 10.264	.798 .225 11.740	.351 2.569 10.711	17.045 945.835 10.897	10.385 19.641 -8.298	.869 19.587 19.614	23.732 19.614 564.528
8 3 8	11.23	7.154 3.527 17.928	.929 40.789 10.497	.835 .228 11.687	.408 1.708 10.971	17.906 999.103 11.088	10.252 19.611 -5.969	.913 19.573 19.592	26.061 19.592 564.528
2 8 8	11.23	7.233 5.955 18.128	1.077 38.361 10.675	.946 .228 11.483	.514 1.477 11.223	18.137 1129.620 11.096	8.740 19.619 -3.541	.925 19.575 19.597	28.489 19.597 564.528
5 7 3	11.22	7.312 7.883 17.938	1.075 36.433 10.756	.927 .228 11.120	.544 1.667 10.972	17.946 1128.192 11.005	8.666 19.593 -1.613	.915 19.593 19.593	30.417 19.593 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

RECT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
73.22	7.391 9.486 16.992	.894 34.918 10.724	.759 .926 10.742	.473 2.621 10.785	16.992 966.406 10.759	10.113 19.619 -2.290	.866 19.569 19.594	31.940 19.594 564.183
5.22	7.473 6.964 14.799	.728 37.352 10.513	.634 .823 10.831	.359 4.814 10.462	14.799 805.177 10.427	10.399 19.648 -2.542	.755 19.614 19.631	29.498 19.631 564.528
81.01	7.849 1.828 14.818	.724 42.498 10.388	.562 .822 11.253	.299 4.795 10.448	14.818 802.148 10.334	10.452 19.614 -7.670	.756 19.581 19.597	24.360 19.597 564.528
3.01	7.628 2.453 16.823	.871 41.863 10.280	.798 .824 11.518	.368 2.798 10.791	16.823 945.388 10.597	10.256 19.594 -7.243	.858 19.539 19.566	24.987 19.566 564.183
91.01	7.707 4.858 18.114	1.097 39.458 10.468	.974 .827 11.542	.505 1.482 10.998	18.131 1146.318 10.943	8.528 19.598 -4.648	.924 19.581 19.589	27.392 19.590 564.183
05.00	7.786 6.200 18.285	1.053 38.116 10.768	.923 .828 11.513	.506 1.355 11.219	18.259 1109.162 11.154	9.058 19.610 -3.296	.931 19.594 19.602	28.734 19.602 564.183
00.00	7.865 7.240 18.146	.931 37.076 10.961	.808 .828 11.420	.462 1.468 11.310	18.146 1000.667 11.166	10.372 19.629 -2.266	.925 19.591 19.610	29.774 19.610 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.919 27.956 .863

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT11 M12/M11

.512 .431 15.925 9.823 564.183 1.169 .980

MIXED EXIT CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT11 MN12 BETA12

.734 .428 15.594 10.350 564.183 1.144 .850 32.218

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	OVY	RN2	DPS/Q1	DEV	TURN
RETAIC	A2/A1						
1.734	.863	.695	1.561	.354	1.421	1.221	.193
.845	.481	1.723	.594	1.193	.492	5.424	36.892
31.558	.451						

OVERALL PERFORMANCE

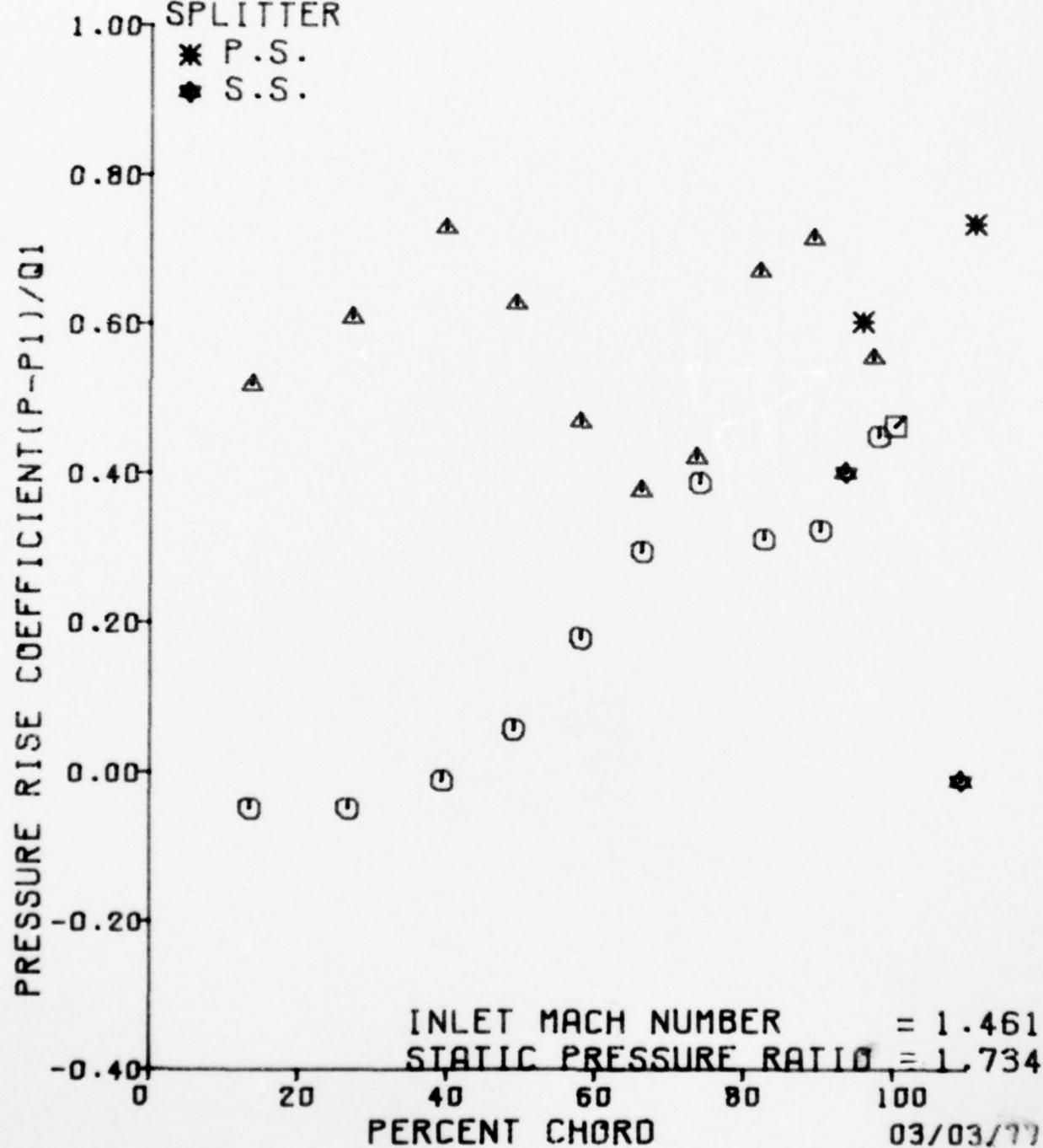
MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	OVY	RN2	DPS/Q1	DEV	TURN
RETAIC	A2/A1						
1.831	.846	.649	1.427	.355	1.469	1.247	.216
.849	.527	1.840	.593	1.135	.556	7.684	36.632
28.111	.477						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

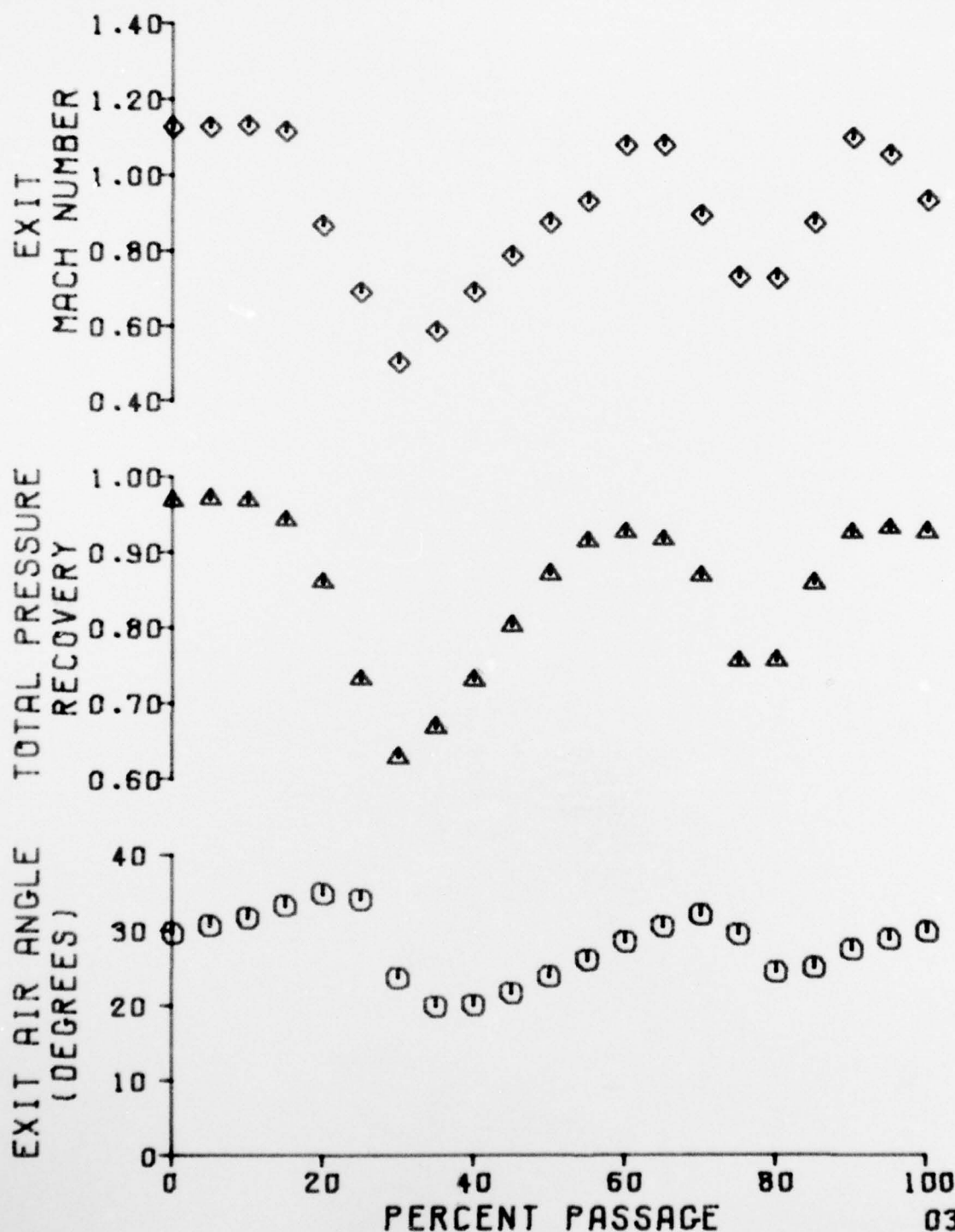


- BLADE
- ▲ P.S.
 - S.S.
 - ◻ T.E.
- SPLITTER
- * P.S.
 - ◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.734



03/03/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.750	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.868	1.504	57.960	24.294	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.143	43.074	1.461	1.200	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.619	19.623	19.628	19.651
11	18.118	6.522	10.268	1.935
13	11.861	9.214	10.780	5.251
15	11.512	9.803	11.783	5.566
17	11.422	14.471	10.911	6.184
19	11.266	11.384	9.582	7.131
21	19.622	10.426	8.861	8.203
23	9.627	14.474	9.621	8.956
25	9.711	10.433	11.497	8.433
27	12.037	8.228	11.826	8.785
29	9.942	9.833	10.501	9.681
31	9.742	14.484	9.754	19.661
33	12.007	9.743	9.745	2.222
35	9.738	10.719	9.742	2.907
37	9.693	9.809	9.741	1.725
39	9.809	14.471	9.864	1.802
41	10.243	10.613	9.857	1.977
43	19.623	14.476	11.161	9.009
45	4.869	10.608	11.958	2.431
47	19.652	19.638	19.658	5.735

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	55%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.894	1.581	.936	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	PL
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.598	19.631	563.838	8.864	65.706

CASCADE INLET CONDITIONS

HN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.630	563.838	66.860	5.656	.237	8.452
I)SS	I)ML	HN)X,1	HN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.482	.574	1.343	1.427	3.471	1.406

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.18 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

E)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.627	33	10.007
25	9.711	35	9.738
27	12.037	37	9.693
29	9.942	39	9.809
31	9.742	41	10.243

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
9.812	.153	9.898	.203	1.047	1.735

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.754
		33	9.745
		35	9.740
		37	9.741
		39	9.864
		41	9.857

MEAN TRAILING EDGE PRESSURE (PSIA) 9.783 RMS DEVIATION .055

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.222 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.907 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.725 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.802 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.245 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.977 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.242 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.299 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.068	5.251	.522	-.048	.513	.268	13.69	13.45
13	10.780	5.251	.606	-.048	.549	.268	26.98	26.63
15	11.783	5.566	.725	-.011	.600	.284	39.60	39.24
17	10.911	5.184	.622	.062	.556	.315	49.07	48.78
19	9.582	7.131	.454	.174	.488	.363	57.88	57.75
21	8.861	8.203	.379	.301	.451	.418	66.00	66.09
23	9.621	8.956	.469	.390	.490	.456	73.41	73.77
25	11.497	8.433	.691	.329	.586	.430	81.70	82.41
27	11.826	8.785	.730	.370	.602	.448	89.05	89.07
29	10.501	9.681	.573	.476	.535	.493	96.93	97.73
0	9.802	9.802	.491	.491	.499	.499	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CO11	CL11	MC1LE	CP1LE
.391	-.323	.220	-34.180	-.024	.390	.143	36.503

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.161	9.009	.651	.397	.569	.459	95.57	93.37
45	11.995	-	.750	-	.611	-	110.63	-
47	-	5.735	-	.009	-	.292	-	109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YF	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DF)1,2 P)AP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/P)11 PT)0 PT)1	BETA)2 PT)0,A T)1
.20	6.284	1.113	.968	.551	18.949	8.729	.965	29.654
	7.120	37.196	.000	.681	1150.043	19.641	19.587	19.614
	18.928	11.097	11.676	11.479	11.380	-2.376	19.614	563.838
5.00	6.363	1.110	.955	.566	18.962	8.768	.966	30.637
	8.103	36.213	.029	.668	1157.457	19.610	19.568	19.589
	18.936	11.234	11.576	11.541	11.404	-1.403	19.589	563.493
9.99	6.442	1.106	.941	.581	18.825	8.749	.959	31.673
	9.139	35.177	.028	.805	1154.045	19.628	19.568	19.598
	18.821	11.312	11.398	11.506	11.309	-0.357	19.598	563.838
14.99	6.521	1.053	.883	.573	18.198	9.028	.927	32.998
	10.464	33.852	.028	1.432	1108.823	19.619	19.591	19.605
	18.198	11.256	11.037	11.361	11.127	.968	19.604	563.838
19.99	6.600	.839	.692	.474	16.677	10.518	.850	34.437
	11.903	32.413	.025	2.954	914.238	19.668	19.628	19.648
	16.677	11.140	10.737	11.093	10.840	2.397	19.648	563.493
24.98	6.679	.678	.565	.374	14.427	10.509	.735	33.504
	10.970	33.346	.021	5.203	754.728	19.626	19.591	19.608
	14.427	10.898	10.735	10.755	10.547	1.464	19.608	563.493
29.98	6.758	.493	.448	.204	12.415	10.516	.632	24.483
	1.940	42.367	.017	7.215	560.139	19.614	19.583	19.599
	12.415	10.544	10.970	10.476	10.352	-7.547	19.598	563.493

62531

228

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1/P	MN12 TURN P1/P	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10,A T111
554		6.838	.578	.535	.194	13.134	10.537	.669	19.882
514	35.24	-2.852	46.958	.216	6.496	642.869	19.628	19.575	19.602
538		13.134	10.341	11.281	10.413	10.309	-12.158	19.601	563.838
537		6.917	.574	.533	.232	14.357	10.589	.731	20.145
589	40.24	-2.389	46.705	.223	5.273	751.172	19.616	19.577	19.596
693		14.357	10.244	11.539	10.445	10.447	-11.895	19.596	563.838
573		6.996	.758	.714	.283	15.686	10.618	.799	21.614
598	45.24	-1.928	45.236	.223	3.945	645.377	19.619	19.588	19.603
638		15.686	10.230	11.704	10.574	10.737	-10.426	19.603	563.493
998		7.275	.854	.782	.344	16.948	10.618	.863	23.724
505	50.23	1.199	43.126	.225	2.682	929.027	19.625	19.570	19.598
638		16.948	10.358	11.797	10.797	10.997	-8.316	19.597	563.838
437		7.154	.916	.823	.403	17.898	10.394	.912	26.103
548	55.23	3.569	42.747	.228	1.732	987.038	19.618	19.584	19.601
693		17.898	10.606	11.772	11.032	11.189	-5.927	19.601	563.638
504		7.233	1.031	.907	.491	18.205	9.273	.927	28.427
508	60.23	5.893	38.423	.228	1.425	1089.669	19.600	19.648	19.669
693		18.204	10.832	11.631	11.109	11.227	-3.603	19.669	563.838
483		7.312	.931	.806	.466	18.000	10.282	.917	30.032
599	65.22	7.496	36.820	.228	1.630	1000.761	19.554	19.606	19.632
693		18.000	10.911	11.314	11.110	11.152	-2.020	19.630	563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)1P	MN12 TURN P)TP	MN1X,2 M12 P)RP	MN1Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
70.22	7.391 8.992 17.017	.873 35.324 10.854	.744 .026 10.944	.456 2.613 10.932	17.017 946.455 10.923	10.358 19.640 -5.044	.867 19.580 19.610	31.526 19.610 563.838
75.22	7.470 6.076 14.850	.715 38.240 10.595	.628 .023 11.016	.343 4.780 10.571	14.850 752.940 10.556	10.560 19.592 -3.430	.756 19.598 19.595	26.610 19.595 563.838
80.21	7.549 1.872 15.134	.735 42.446 10.409	.669 .022 11.396	.304 4.496 10.589	15.134 812.524 10.516	10.570 19.668 -7.628	.771 19.611 19.639	24.404 19.639 563.838
85.21	7.520 2.436 17.011	.863 41.880 10.438	.783 .025 11.680	.364 2.620 10.897	17.011 937.294 10.784	10.461 19.640 -7.260	.867 19.624 19.631	24.970 19.632 564.183
90.21	7.707 4.687 18.126	1.032 39.629 10.609	.918 .028 11.672	.472 1.524 11.143	18.127 1090.509 11.100	9.213 19.611 -4.819	.922 19.579 19.595	27.221 19.595 563.838
95.20	7.786 6.009 18.279	.974 38.307 10.871	.856 .028 11.613	.465 1.351 11.305	18.279 1039.529 11.240	9.949 19.593 -3.487	.931 19.540 19.566	28.543 19.566 564.183
100.20	7.853 7.181 18.172	.927 37.135 11.039	.805 .028 11.508	.460 1.458 11.383	18.172 995.803 11.266	10.430 19.654 -2.315	.926 19.608 19.631	29.715 19.631 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.888 27.856 .863

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/TT12	M12/M11
.785	.415	16.933	10.145	563.838	1.158	.979

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/TT12	MN12	BETA12
.721	.413	16.522	10.571	563.838	1.138	.831	29.784

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

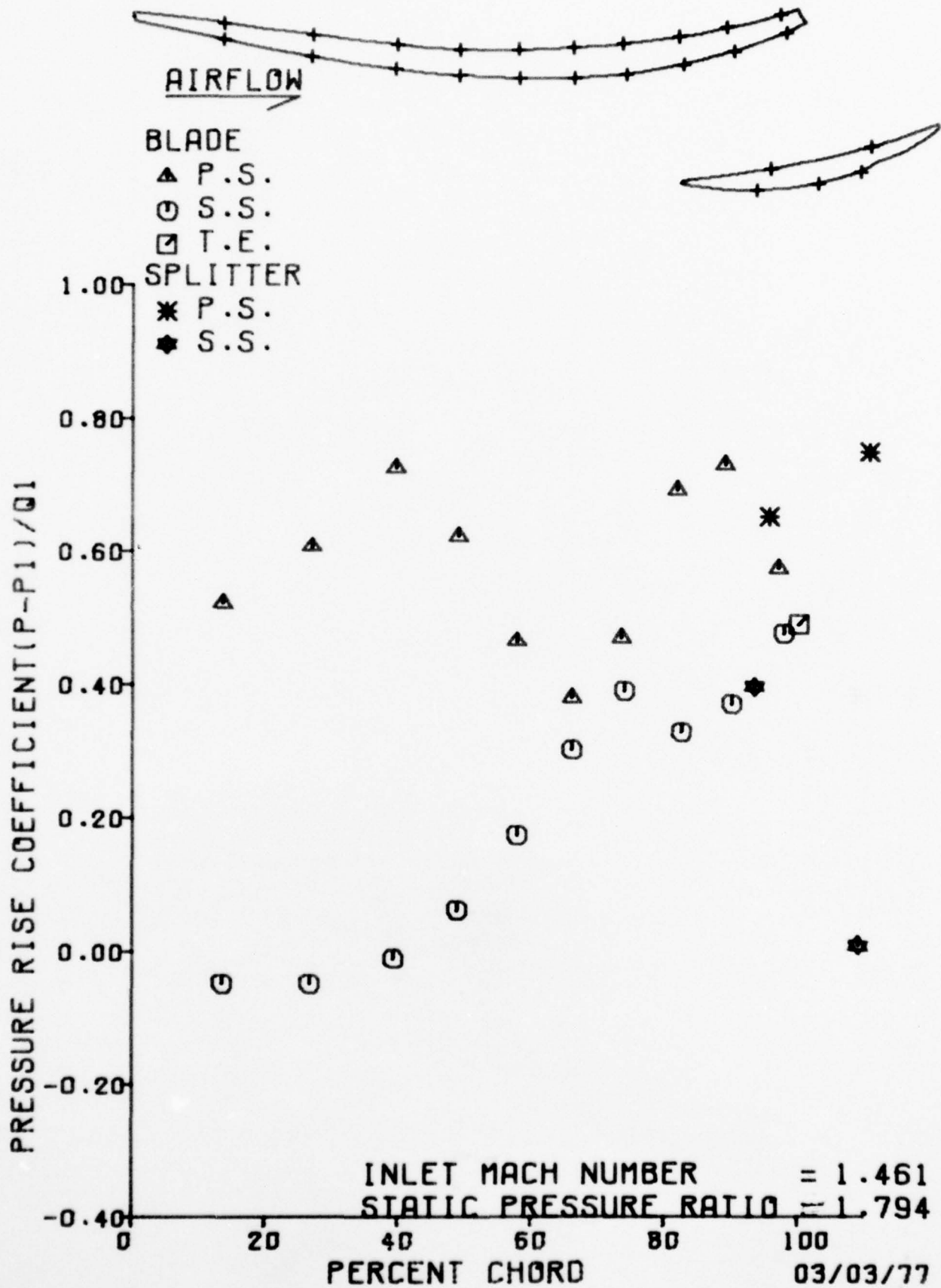
P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	DVY	RN2	DPS/Q1	DEV	TURN
BETAIC	A2/A1						
1.794	.863	.675	1.517	.343	1.455	1.233	.193
.845	.484	1.773	.604	1.180	.531	5.322	38.994
31.017	.453						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

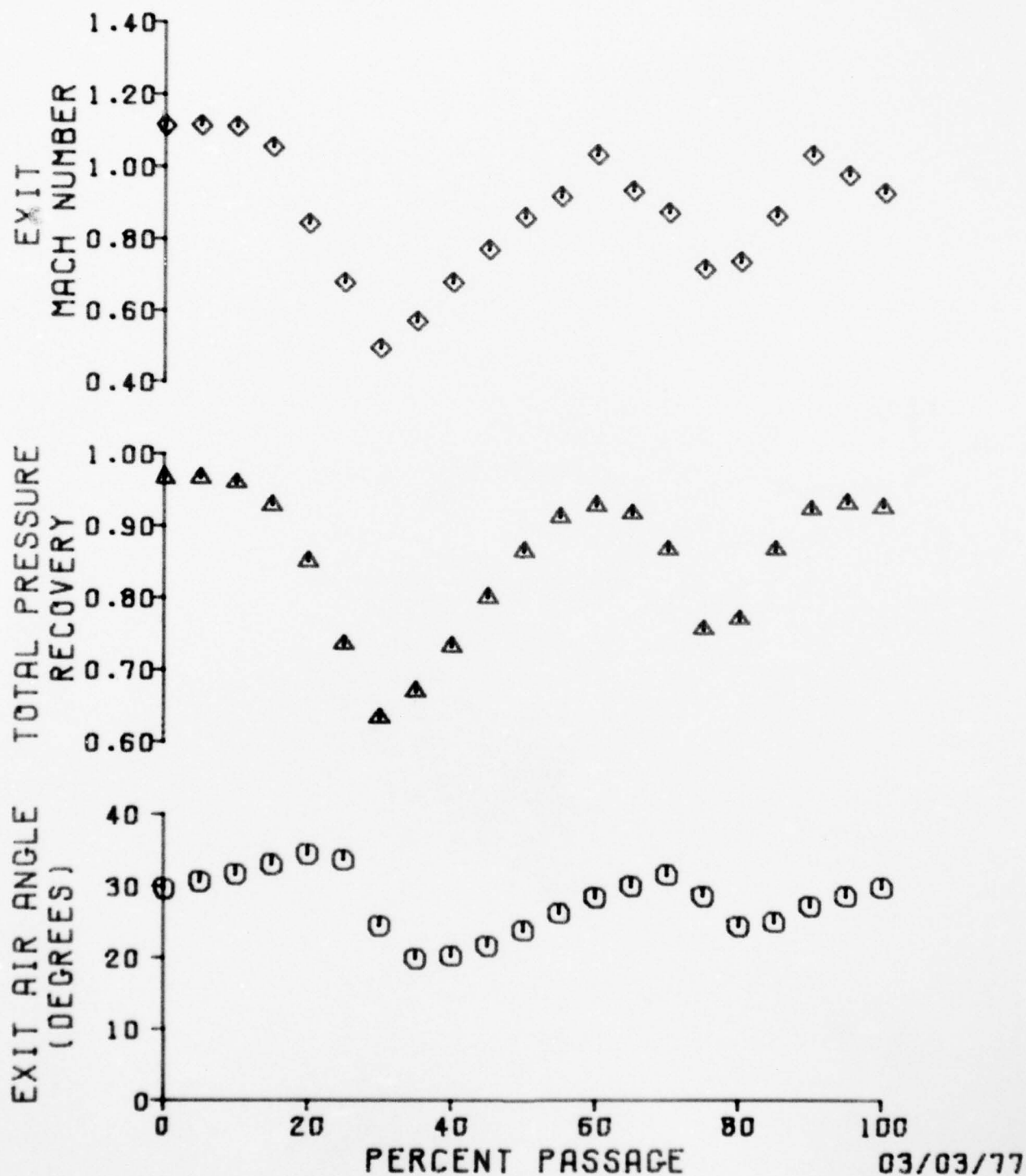
P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEQ	DVY	RN2	DPS/Q1	DEV	TURN
BETAIC	A2/A1						
1.859	.847	.537	1.406	.344	1.491	1.254	.215
.849	.522	1.878	.603	1.125	.582	7.250	37.066
27.570	.477						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.794





326651

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.794

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.747	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.504	57.970	24.295	564.183

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.145	43.077	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.625	19.616	19.612	19.608
11	18.223	8.518	12.579	1.911
13	11.021	9.715	12.920	5.259
15	11.593	10.063	11.805	5.614
17	11.414	14.474	12.927	6.617
19	11.313	11.478	9.589	7.671
21	10.561	10.434	8.883	8.648
23	9.715	14.473	9.890	9.227
25	9.803	10.446	11.612	8.379
27	10.112	8.258	11.905	8.841
29	10.223	9.962	10.606	9.811
31	9.813	14.483	9.875	19.645
33	10.083	9.949	9.869	2.202
35	9.827	10.796	9.866	2.866
37	9.788	9.921	9.862	1.714
39	9.925	14.469	9.998	1.782
41	10.339	10.705	9.991	1.950
43	10.635	14.475	11.242	9.282
45	4.915	10.650	12.085	2.453
47	19.661	19.660	19.667	5.897

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	55%

2

43/23/27

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.024	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS (DEGREES)	FL	ML (DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

MMO	PTO	TTO	P/O	BETA/O
1.500	19.615	564.183	8.854	65.705

CASCADE INLET CONDITIONS

MM1	PT1	TT1	BETA1	P1	M1	Q1
1.461	19.615	564.183	66.850	5.652	.237	8.445
I1SS	I1ML	MMY,1	MMY,1	TI/T11	PI/P11	NR/10**6
1.371	3.402	.574	1.343	1.427	3.470	1.404

62581

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO.12 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.715	33	10.083
25	9.803	35	9.827
27	10.112	37	9.788
29	10.023	39	9.905
31	9.813	41	10.339

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.893	.149	9.988	.202	1.039	1.750

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.875
		33	9.869
		35	9.866
		37	9.862
		39	9.998
		41	9.991

MEAN TRAILING EDGE PRESSURE (PSIA) 9.910 RMS DEVIATION .060

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.202 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.866 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.714 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.782 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.769 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.950 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.039 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.286 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.270

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.579	5.259	.583	-.047	.539	.268	13.69	13.45
13	10.920	5.259	.624	-.047	.557	.268	26.98	26.63
15	11.805	5.514	.729	-.005	.602	.286	39.60	39.24
17	10.927	6.517	.625	.114	.557	.337	49.07	48.78
19	9.589	7.571	.466	.239	.489	.391	57.88	57.75
21	8.883	8.548	.383	.355	.453	.441	66.00	66.09
23	9.890	9.227	.502	.423	.504	.470	73.41	73.77
25	11.612	8.379	.706	.323	.592	.427	81.70	82.41
27	11.995	8.841	.740	.378	.607	.451	89.05	89.97
29	10.606	9.811	.587	.492	.541	.500	96.93	97.73
30	9.930	9.930	.507	.507	.506	.506	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	FC)LE	CP)LE
.390	-.324	.218	-34.010	-.025	.390	.138	35.247

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.242	9.282	.562	.406	.573	.463	95.57	93.37
45	12.085	-	.762	-	.615	-	110.63	-
47	-	5.897	-	.029	-	.301	-	109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT12P	MN12 TURN PT1P	MN1Y,2 M12 P12P	MN1Y,2 DP11,2 P11P	PT12 V12 P12P	P12 PT10 BETA12P	PT12/PT11 P110 PT11	BETA12 PT10,A T111
.20	5.284	1.183	.968	.544	18.923	8.827	.965	29.559
	7.825	37.291	.888	.692	1151.916	19.597	19.591	19.594
	18.921	11.125	11.724	11.526	11.436	-2.471	19.594	563.838
5.20	6.353	1.299	.945	.566	18.962	8.897	.967	30.622
	8.988	36.228	.929	.653	1147.941	19.657	19.604	19.631
	18.943	11.298	11.839	11.586	11.439	-1.408	19.630	564.183
9.20	6.442	1.298	.934	.576	18.802	8.832	.959	31.649
	9.115	35.201	.928	.813	1147.177	19.667	19.623	19.645
	18.784	11.354	11.448	11.580	11.376	-.391	19.645	563.838
14.99	6.521	.927	.777	.595	18.271	10.371	.921	33.015
	10.481	33.835	.827	1.544	997.182	19.702	19.657	19.679
	18.871	11.291	11.993	11.396	11.171	.985	19.679	564.183
19.99	6.600	.820	.581	.458	15.542	10.632	.843	33.906
	11.372	32.944	.825	3.074	896.737	19.598	19.575	19.587
	16.542	11.115	10.810	11.137	10.886	1.876	19.586	563.838
24.98	6.679	.670	.561	.365	14.366	10.636	.732	33.272
	10.538	33.778	.921	5.249	745.903	19.608	19.589	19.604
	14.386	10.870	10.757	10.781	10.618	1.042	19.603	564.183
29.98	6.758	.496	.450	.208	12.534	10.596	.639	24.805
	2.271	42.245	.217	7.081	563.805	19.642	19.620	19.631
	12.534	10.616	11.234	10.557	10.460	-7.225	19.630	564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)2,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)C BETA)P	PT)2/PT)1 PT)C PT)1	BETA)2 PT)0,4 TT)1
59		6.838	.566	.529	.202	13.218	10.637	.674	20.935
64	35.24	-1.599	45.915	.217	6.397	638.745	19.648	19.605	19.626
68		13.218	10.463	11.316	10.550	10.434	-11.095	19.626	564.183
22		6.917	.566	.623	.238	14.360	10.661	.732	20.889
31	47.24	-1.645	45.961	.219	5.255	743.647	19.628	19.577	19.603
63		14.360	10.337	11.531	10.555	10.547	-11.141	19.602	564.183
49		6.996	.758	.792	.285	15.582	10.652	.794	22.129
45	45.24	-1.425	44.721	.223	4.034	835.414	19.619	19.566	19.593
38		15.582	10.332	11.700	10.647	10.760	-9.911	19.592	564.183
15		7.075	.839	.767	.340	16.864	10.638	.860	23.947
79	50.23	1.413	42.903	.025	2.751	914.372	19.687	19.608	19.648
63		16.864	10.474	11.838	10.855	11.028	-8.083	19.647	564.183
26		7.154	.895	.805	.391	17.808	10.583	.908	25.929
87	55.23	3.305	40.921	.027	1.807	967.701	19.525	19.609	19.617
38		17.808	10.653	11.822	11.095	11.240	-6.101	19.616	563.838
72		7.233	.926	.819	.433	18.075	10.385	.921	27.859
64	62.23	5.325	38.992	.028	1.541	996.231	19.627	19.575	19.601
63		18.075	10.828	11.668	11.189	11.261	-4.161	19.600	563.838
15		7.312	.916	.794	.456	17.860	10.383	.911	29.848
11	65.22	7.314	37.002	.028	1.755	986.437	19.561	19.578	19.570
63		17.860	10.903	11.334	11.167	11.195	-2.192	19.569	564.183

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	M)2 TURN P)TP	M)X,2 M)2 P)BP	M)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 9.029 17.258	.863 35.307 12.907	.735 .025 10.993	.452 2.548 11.028	17.068 937.580 10.993	10.496 19.613 -1.487	.870 19.582 19.597	31.543 19.597 564.183
75.22	7.472 8.869 14.992	.716 37.447 10.715	.624 .023 11.243	.351 4.624 10.704	14.992 793.841 10.672	10.654 19.663 -2.637	.764 19.621 19.642	29.403 19.642 564.183
80.21	7.549 2.877 14.951	.714 41.439 10.501	.545 .022 11.318	.307 4.654 10.662	14.951 792.204 10.532	10.641 19.636 -6.629	.762 19.598 19.617	25.411 19.617 563.838
85.21	7.628 3.229 16.440	.626 41.087 10.477	.744 .024 11.495	.359 3.175 10.851	15.440 902.006 10.674	10.508 19.602 -6.277	.838 19.552 19.576	25.763 19.577 564.183
90.21	7.707 4.252 17.278	.879 40.064 10.587	.784 .026 11.545	.396 2.337 11.056	17.278 952.181 10.918	10.452 19.644 -5.254	.881 19.587 19.615	26.786 19.616 563.838
95.20	7.786 5.006 17.598	.883 39.310 10.782	.783 .027 11.623	.408 2.217 11.264	17.598 956.506 11.141	10.594 19.650 -4.500	.897 19.612 19.631	27.540 19.631 564.183
100.20	7.865 6.355 18.226	.929 37.961 10.984	.813 .028 11.622	.449 1.390 11.390	18.226 998.500 11.290	10.443 19.672 -3.141	.929 19.636 19.653	28.889 19.654 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.851 27.912 .855

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.752	.399	16.778	10.445	564.183	1.145	.967

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.703	.397	16.492	10.739	564.183	1.130	.897	29.460

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

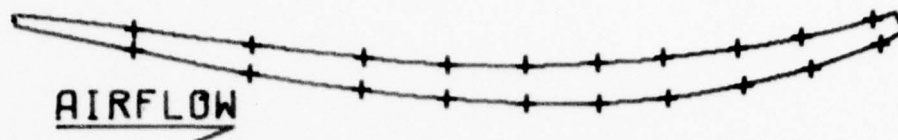
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/01	DEV	TURN
BETA)C	A)2/A)1						
1.848	.855	.651	1.462	.331	1.483	1.246	.203
.047	.511	1.841	.615	1.148	.568	5.378	38.938
29.304	.461						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/01	DEV	TURN
BETA)C	A)2/A)1						
1.980	.841	.621	1.375	.332	1.505	1.262	.224
.051	.541	1.928	.614	1.102	.602	6.926	37.390
25.826	.483						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

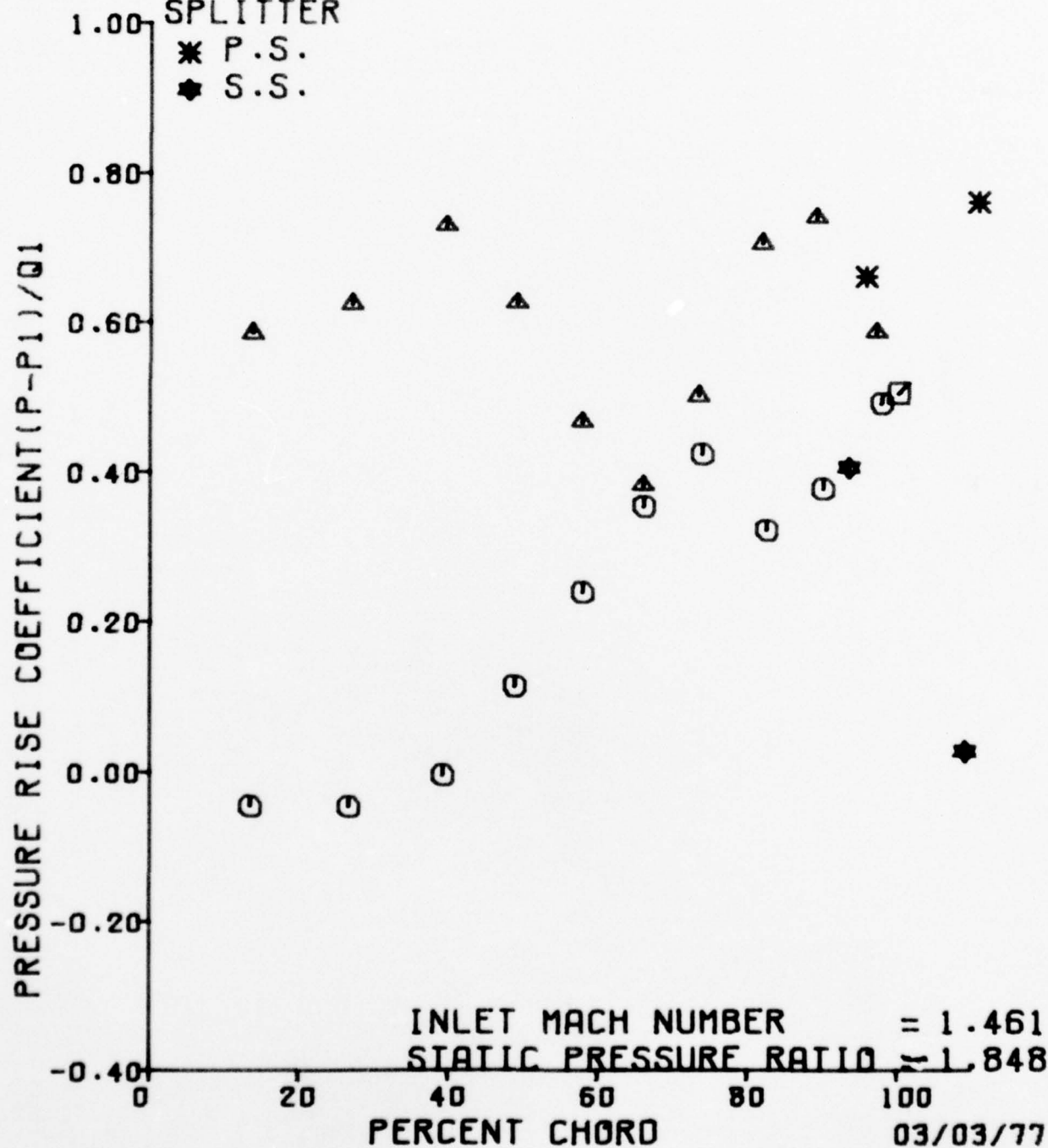
○ S.S.

◻ T.E.

SPLITTER

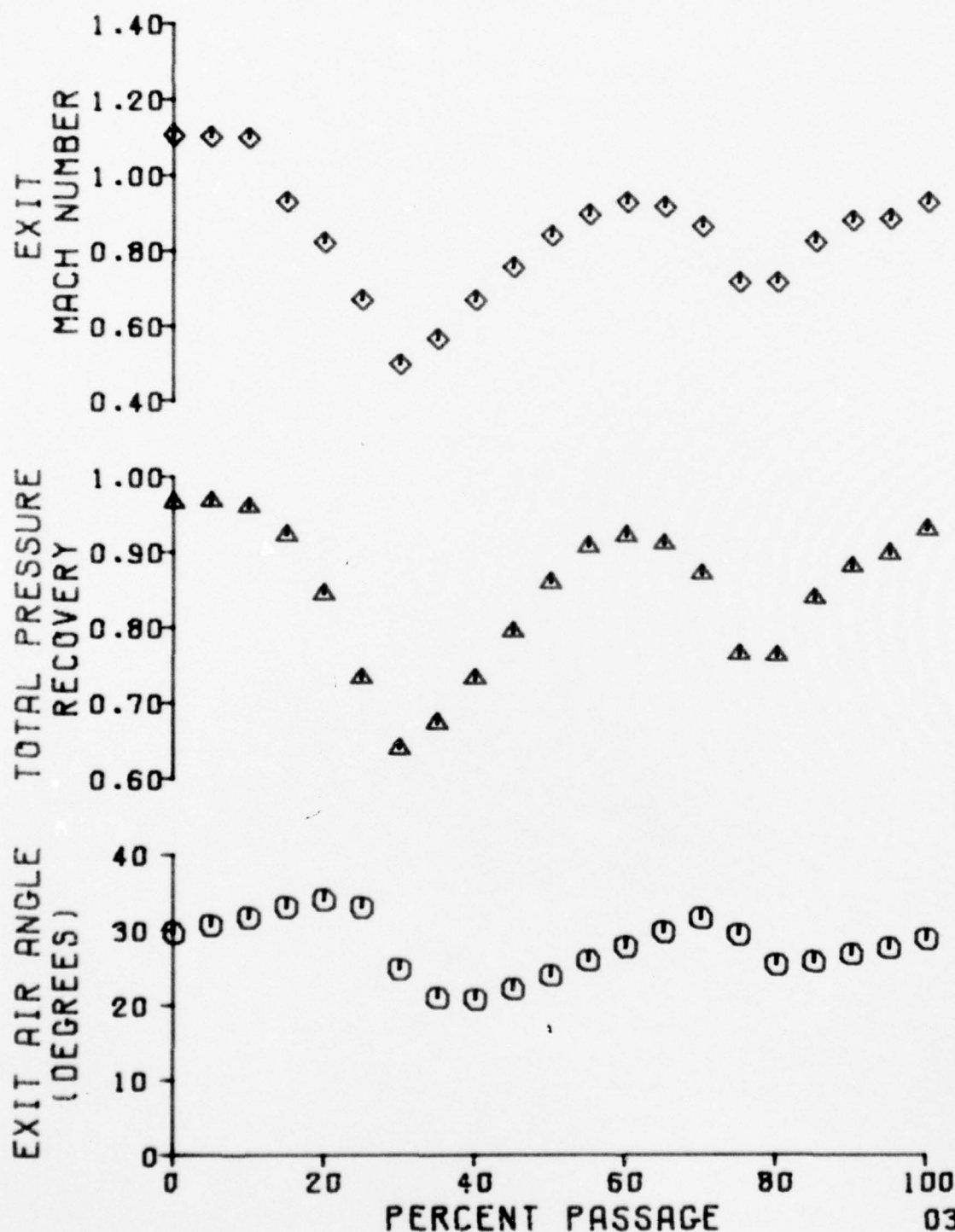
* P.S.

◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.848



03/03/77



326653

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.848

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.802	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.868	1.504	57.960	24.294	564.183

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.143	43.074	1.461	1.000	1.258

02581

243

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

AXIAL N (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	19.637	19.617	19.627	19.635
	11	17.548	8.527	10.642	1.845
	13	11.022	10.177	11.033	5.292
	15	11.707	10.394	11.867	5.685
	17	11.472	14.474	10.962	7.168
	19	11.297	11.555	9.600	8.118
	21	19.575	10.461	8.995	9.089
	23	9.970	14.475	10.497	9.452
	25	10.048	10.467	11.852	8.477
	27	10.337	8.354	12.091	9.225
	29	10.215	10.232	10.839	10.149
	31	10.030	14.485	10.191	19.615
	33	10.324	10.333	10.183	2.183
	35	10.091	10.962	10.177	2.887
	37	10.040	10.137	10.172	1.767
	39	10.146	14.471	10.321	1.819
	41	10.543	10.878	10.313	1.952
	43	19.645	14.478	11.600	9.146
	45	4.906	19.601	12.260	2.444
	47	19.624	19.597	19.626	6.287

STATIC
PRESSURE
RATIO

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	55%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.224	1.531	.936	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
RS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN10	PT10	TT10	M10	BETA10
1.588	19.625	564.183	8.849	65.726

CASCADE INLET CONDITIONS

PN11	PT11	TT11	BETA11	P11	M11	Q11
1.461	19.625	564.183	66.852	5.649	.237	8.441
11SS	11ML	MN1Y,1	MN1Y,1	TT/111	PT/P11	NR/10**6
1.371	3.482	.574	1.343	1.427	3.471	1.403

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

ANF)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.978	33	10.324
25	10.048	35	10.091
27	10.337	37	10.040
29	10.215	39	10.146
31	10.030	41	10.543

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
12.120	.135	12.220	.184	1.020	1.792

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.191
		33	10.183
		35	10.177
		37	10.172
		39	10.321
		41	10.313

MEAN TRAILING EDGE PRESSURE [PSIA] 10.226 RMS DEVIATION .064

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.183 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.887 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.767 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.819 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.114 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.952 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.054 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.334 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.082

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
1	10.642	5.292	.592	-.042	.543	.270	13.69	13.45
3	11.033	5.292	.638	-.042	.563	.270	26.98	26.63
5	11.867	5.685	.737	.004	.605	.290	39.80	39.24
7	10.962	7.168	.629	.180	.559	.366	49.37	48.78
9	9.600	8.118	.468	.293	.490	.414	57.88	57.75
11	8.995	9.089	.396	.408	.459	.464	66.00	66.09
13	10.497	9.452	.574	.451	.535	.482	73.41	73.77
15	11.852	8.477	.735	.335	.605	.432	81.70	82.41
17	12.091	9.225	.763	.424	.617	.471	88.05	89.97
19	10.839	10.149	.615	.533	.553	.518	96.93	97.73
21	10.247	10.247	.545	.545	.523	.523	100.00	100.00
	FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC1LE	CP1LE
	.381	-.316	.213	-33.923	-.725	.380	.132	34.503

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
13	11.600	9.146	.705	.414	.592	.466	95.57	93.37
15	12.260		.783		.625		112.63	
17		6.287		.076		.321		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NF	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.20	6.284	1.053	.917	.517	18.887	9.369	.963	29.423
	6.889	37.427	.000	.718	1109.182	19.635	19.605	19.620
	18.884	11.250	11.873	11.671	11.555	-2.617	19.620	564.528
5.20	6.363	1.033	.889	.525	18.848	9.580	.961	30.560
	8.026	36.290	.029	.757	1091.570	19.666	19.609	19.632
	18.847	11.410	11.751	11.710	11.525	-1.480	19.637	564.183
9.99	6.442	.916	.781	.478	18.425	10.710	.940	31.449
	8.915	35.401	.028	1.180	986.511	19.615	19.590	19.602
	18.425	11.415	11.535	11.560	11.408	-.591	19.602	564.183
14.99	6.521	.871	.735	.466	17.648	10.762	.900	32.344
	9.810	34.508	.027	1.957	945.114	19.637	19.592	19.615
	17.648	11.320	11.264	11.505	11.232	.304	19.614	564.528
19.99	6.600	.789	.661	.430	16.338	10.837	.833	33.056
	10.522	33.794	.025	3.267	866.084	19.635	19.558	19.596
	16.338	11.173	11.017	11.282	11.031	1.016	19.596	564.183
24.98	6.679	.647	.548	.347	14.389	10.861	.734	32.414
	9.880	34.436	.021	5.216	723.442	19.641	19.593	19.617
	14.389	11.020	10.981	11.034	10.855	.374	19.616	564.528
29.98	6.758	.491	.441	.216	12.716	10.784	.640	26.068
	3.534	40.782	.017	6.888	558.315	19.655	19.596	19.626
	12.716	10.819	11.162	10.769	10.685	-5.972	19.625	564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 F1SP	F12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
3	35.34	6.838	.551	.510	.210	13.271	10.706	.677	22.345
8		-.188	44.504	.016	6.334	622.986	19.636	19.577	19.606
8		13.271	19.650	11.366	10.722	10.671	-9.694	19.606	564.183
8	40.34	6.917	.539	.592	.240	14.263	10.838	.728	22.019
8		-.515	44.831	.210	5.342	715.205	19.612	19.581	19.596
8		14.263	19.578	11.583	10.754	10.756	-10.021	19.596	564.528
9	45.34	6.996	.718	.663	.276	15.360	10.892	.784	22.603
2		.269	44.247	.022	4.244	796.327	19.623	19.592	19.607
3		15.360	19.543	11.743	10.814	10.904	-9.437	19.607	564.528
4	52.23	7.075	.804	.734	.328	16.595	10.843	.846	24.085
5		1.551	42.765	.025	3.010	881.237	19.618	19.560	19.589
8		16.595	19.829	11.891	10.977	11.072	-7.955	19.568	564.183
6	55.23	7.154	.877	.789	.384	17.671	10.707	.901	25.977
6		3.443	40.873	.027	1.934	950.811	19.638	19.584	19.611
8		17.671	19.786	11.912	11.183	11.251	-6.063	19.611	564.183
14	60.23	7.233	.918	.810	.430	18.197	10.553	.928	27.972
17		5.438	38.878	.028	1.408	988.464	19.694	19.650	19.672
28		18.197	19.943	11.759	11.307	11.341	-4.068	19.672	564.183
68	65.22	7.312	.927	.802	.464	18.097	10.388	.923	30.055
26		7.521	36.795	.028	1.508	997.025	19.652	19.601	19.627
83		18.097	11.038	11.438	11.305	11.231	-1.985	19.626	564.183

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	FN)2 TURN F)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)MP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 9.196 17.116	.863 35.126 19.966	.734 .826 11.842	.454 2.489 11.125	17.116 937.580 11.008	10.526 19.626 -3.316	.873 19.582 19.604	31.724 19.604 564.528
75.22	7.478 6.788 14.981	.784 37.528 10.763	.614 .823 11.991	.345 4.784 10.788	14.901 782.166 10.748	10.701 19.622 -2.718	.760 19.585 19.604	29.322 19.604 564.183
80.21	7.549 3.179 15.242	.729 41.137 10.575	.657 .822 11.392	.316 4.363 10.752	15.242 807.281 10.692	10.699 19.629 -6.327	.777 19.581 19.604	25.713 19.605 564.183
85.21	7.628 3.891 16.978	.858 40.425 10.593	.769 .825 11.574	.382 2.627 10.937	16.978 933.047 10.878	10.493 19.632 -5.615	.866 19.593 19.612	26.425 19.613 564.183
90.21	7.707 5.177 17.826	.911 39.139 10.740	.806 .827 11.585	.424 1.779 11.147	17.826 982.184 11.099	10.415 19.698 -4.329	.909 19.641 19.669	27.711 19.670 564.183
95.00	7.786 6.491 18.098	.919 37.825 10.918	.803 .828 11.517	.446 1.597 11.285	18.008 989.458 11.146	10.431 19.640 -3.015	.919 19.585 19.612	29.025 19.613 564.183
100.00	7.865 7.325 18.189	.895 37.011 11.272	.776 .828 11.703	.445 1.416 11.530	18.189 967.116 11.501	10.817 19.634 -2.201	.928 19.581 19.607	29.839 19.608 564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MA12 BETA12 PT12/PT11

.629 28.207 .857

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MA12	MA12	PT12	P12	TT12	TT12/T12	M12/M11
.731	.392	16.609	10.706	564.183	1.138	.964

MIXED EXIT CONDITIONS

MA12	MA12	PT12	P12	TT12	TT12/T12	MA12	BETA12
.689	.391	16.543	10.942	564.183	1.125	.792	29.562

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

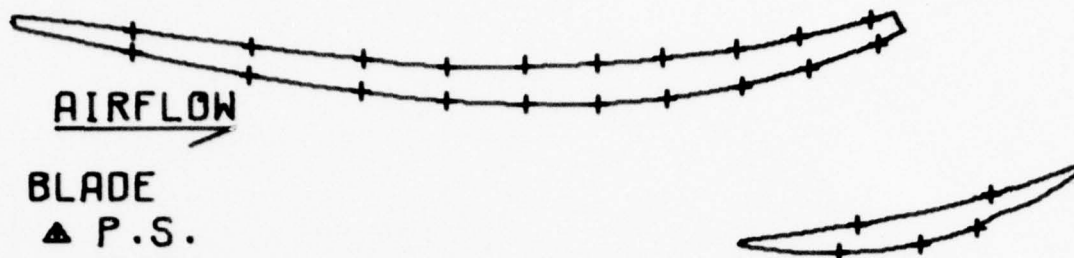
P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EG	CV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.895	.857	.635	1.425	.327	1.511	1.254	.200
.046	.527	1.884	.619	1.137	.599	5.673	38.643
28.862	.464						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EG	CV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.937	.844	.610	1.350	.327	1.528	1.268	.219
.050	.553	1.964	.618	1.095	.627	7.028	37.288
25.506	.485						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

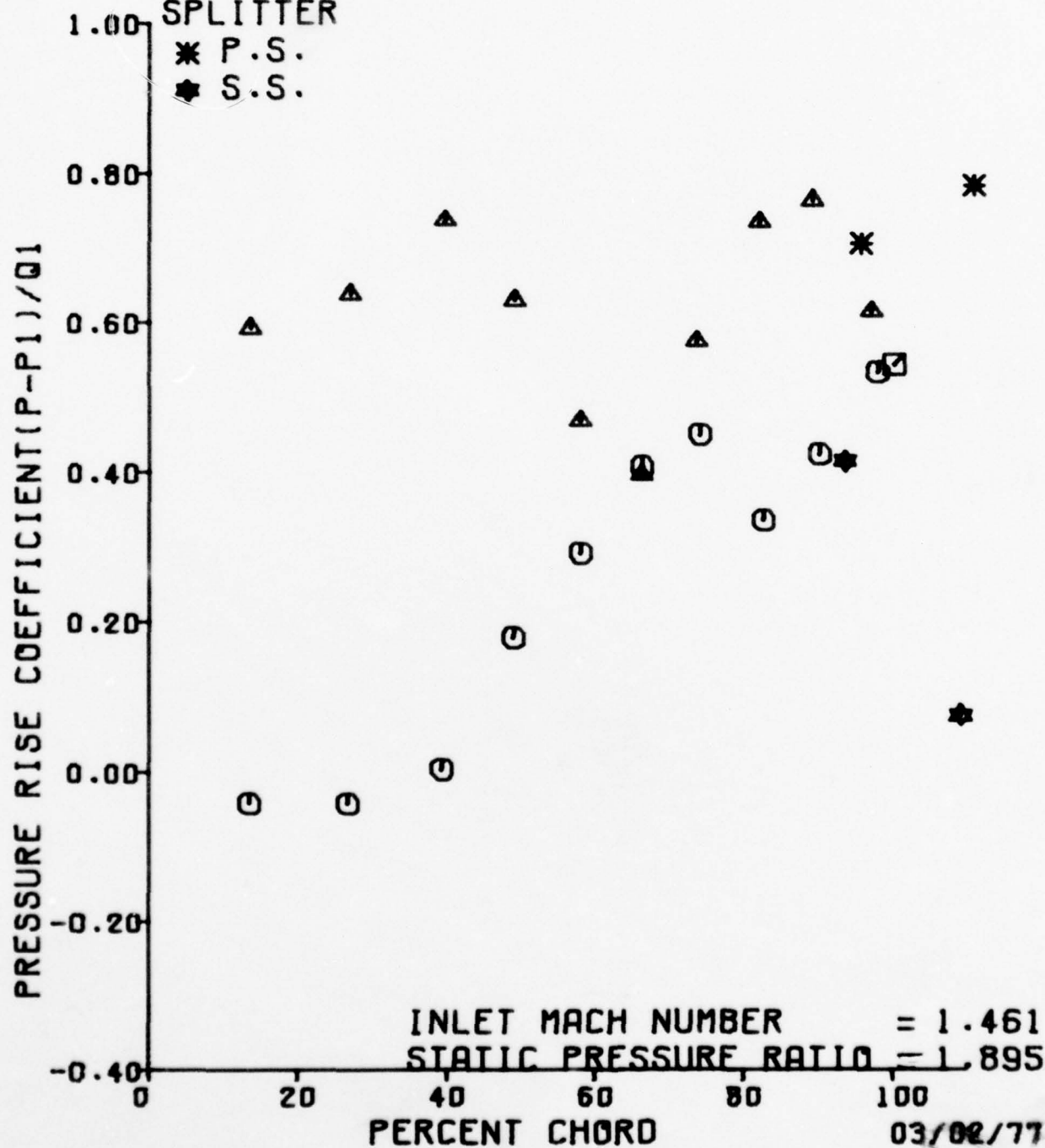
○ S.S.

◻ T.E.

SPLITTER

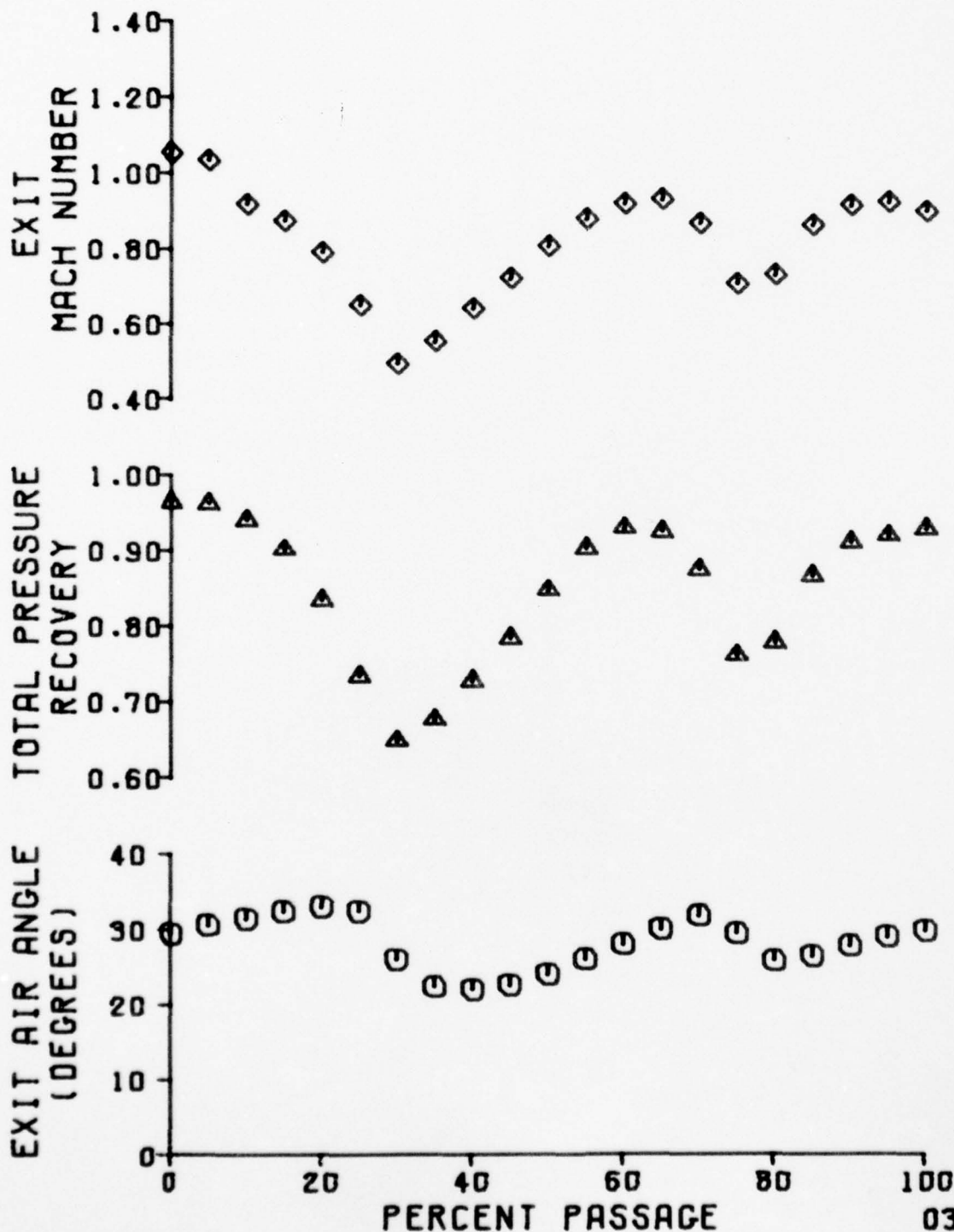
* P.S.

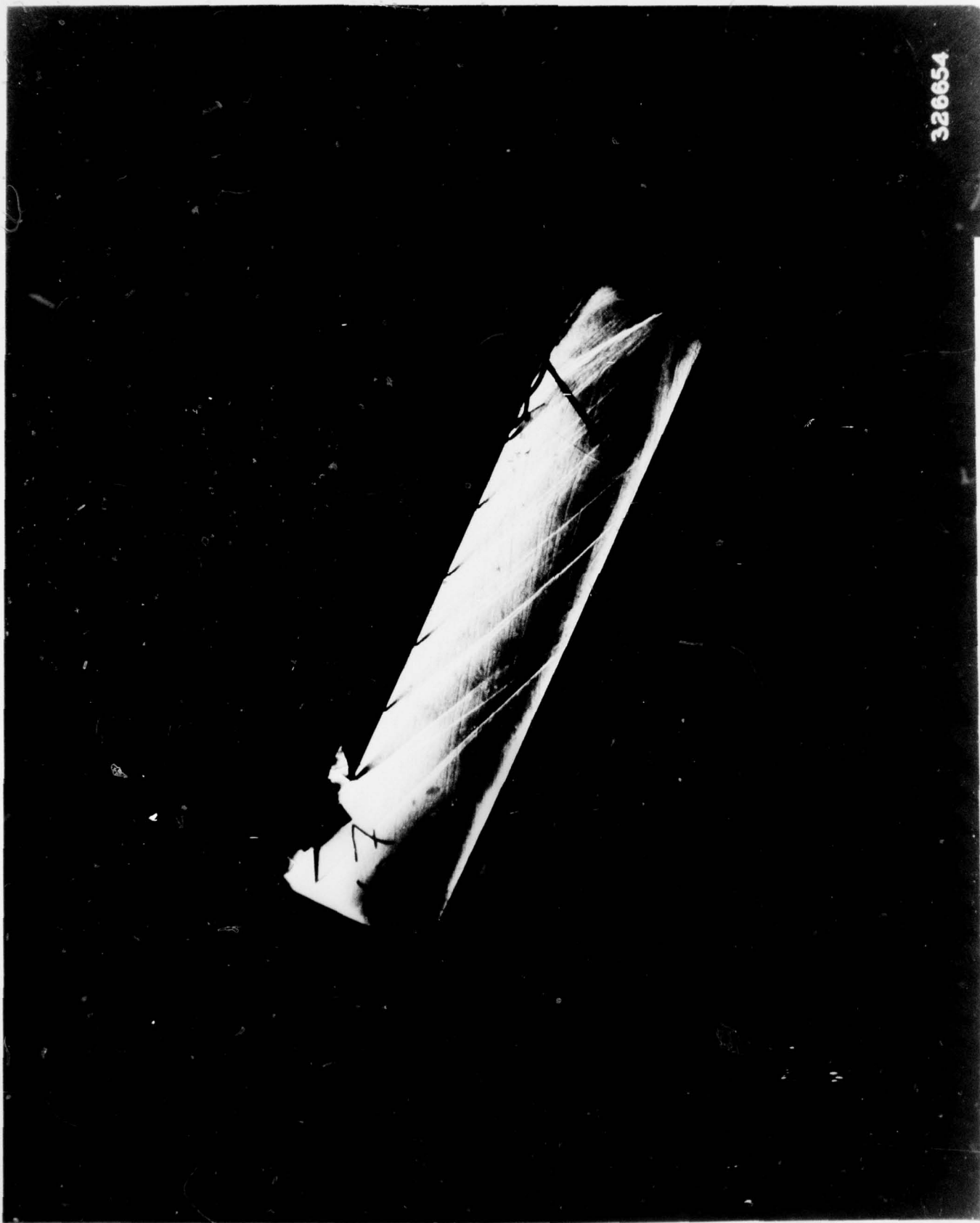
◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.895





326654

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.895

APPENDIX F

CASCADE DATA

SPLITTER VANE POSITION = 60%

$$P)_2/P)_1 = 1.625$$

$$P)_2/P)_1 = 1.805$$

$$P)_2/P)_1 = 1.965$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.691	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.573	1.503	57.550	24.330	559.355

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION + EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.937	19.932	19.934	19.943
11	16.185	6.631	10.897	11.201
13	9.672	10.358	11.149	5.574
15	11.725	10.678	11.394	5.769
17	10.101	14.458	10.316	7.297
19	10.393	11.839	9.096	8.236
21	19.878	10.154	8.881	9.228
23	8.594	14.457	8.946	9.546
25	8.898	11.519	10.797	7.065
27	9.097	6.524	11.561	7.060
29	9.125	6.527	9.973	8.085
31	8.726	14.466	8.546	19.928
33	8.932	8.638	8.540	2.323
35	8.744	9.091	8.535	2.634
37	8.647	8.827	8.530	1.717
39	8.826	14.452	8.291	1.770
41	9.505	9.927	8.283	1.619
43	19.904	14.461	7.497	8.598
45	4.972	19.910	10.855	6.544
47	19.896	19.909	19.920	5.164

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.165	.045	60%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.904	559.355	9.023	65.670

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	19.903	559.355	66.850	5.745	.242	8.570

I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.422	.574	1.342	1.426	3.464	1.440

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	8.594	33	8.932
25	8.896	35	8.744
27	9.097	37	8.647
29	9.125	39	8.826
31	8.726	41	9.505

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
8.868	.206	8.931	.302	1.138	1.547

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	8.546
		33	8.540
		35	8.535
		37	8.530
		39	8.291
		41	8.283

MEAN TRAILING EDGE PRESSURE [PSIA] 8.454 RMS DEVIATION .118

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.303 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.634 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.717 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.770 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.355 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.619 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.294 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.071

62531

256

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	OPS/Q1 (PS)	OPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	12.897	5.574	.601	-.020	.548	.280	13.69	13.45
13	11.149	5.574	.631	-.020	.560	.280	26.98	26.63
15	11.394	5.769	.659	.003	.572	.290	39.60	39.24
17	10.310	7.297	.533	.181	.518	.367	49.07	48.78
19	9.090	8.235	.391	.291	.457	.414	57.88	57.75
21	8.881	9.228	.366	.406	.446	.464	66.00	66.09
23	8.946	9.546	.374	.444	.449	.480	73.41	73.77
25	10.797	7.065	.589	.154	.542	.355	81.70	82.41
27	11.561	7.060	.679	.153	.581	.355	89.05	89.97
29	9.973	8.085	.493	.273	.501	.406	96.93	97.73
0	8.411	8.411	.311	.311	.423	.423	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CO)1	CL)1	MC)LE	CP)LE
.354	-.288	.205	-35.421	-.014	.353	.125	35.247

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	OPS/Q1 (PS)	OPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
45	7.497	8.598	.204	.333	.377	.432	95.57	93.37
46	10.855	8.544	.596	.093	.545	.329	110.63	102.50
47		5.184		-.068		.259		109.00

J

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)TP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	6.996 -5.508 16.656	.895 44.824 9.083	.830 .000 11.557	.336 3.247 10.317	16.656 963.552 10.244	9.898 19.942 -10.424	.837 19.891 19.916	22.026 19.917 559.355
5.00	7.075 2.549 17.659	1.111 41.767 9.693	1.000 .028 11.557	.471 2.219 10.571	17.684 1153.045 10.509	8.175 19.942 -7.367	.889 19.881 19.911	25.083 19.912 559.355
9.99	7.104 4.849 18.255	1.149 39.467 10.098	1.020 .028 11.306	.528 1.579 10.667	18.324 1184.666 10.649	8.071 19.945 -5.067	.921 19.904 19.924	27.383 19.924 559.355
14.99	7.233 7.941 18.342	1.169 36.375 10.237	1.008 .026 10.716	.593 1.477 10.556	18.426 1201.015 10.557	7.910 19.929 -1.975	.926 19.902 19.915	30.475 19.916 559.355
19.99	7.312 8.677 18.357	.927 35.639 10.133	.793 .026 10.359	.481 3.546 10.055	16.357 993.173 10.134	9.384 19.937 -1.239	.822 19.879 19.907	31.211 19.908 559.700
24.98	7.391 2.649 14.248	.752 41.667 9.755	.681 .023 10.665	.320 5.656 9.684	14.248 826.288 9.836	9.792 19.929 -7.267	.716 19.877 19.902	25.183 19.903 559.355
29.98	7.470 1.963 15.822	.671 42.353 9.621	.793 .023 10.932	.361 4.081 9.827	15.822 940.807 10.140	9.651 19.927 -7.953	.795 19.887 19.907	24.497 19.907 559.700

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

ETA)2 T)0,A T)1	PERCT	Y DEV P)YP	MN)2 TLRN P)TP	MN)X,2 M)2 P)DP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 P)0 P)1	BETA)2 PT)0,A T)1
22.026 19.917 59.355	35.24	7.552 4.277 17.189	1.098 42.239 9.832	.982 .026 11.129	.492 2.697 10.257	17.206 1142.731 10.440	8.077 19.930 -5.839	.864 19.883 19.906	26.611 19.907 559.355
25.083 19.912 59.355	40.24	7.629 5.019 17.463	1.088 39.297 10.081	.964 .027 11.163	.503 2.427 10.561	17.476 1133.991 10.612	8.310 19.922 -4.897	.878 19.886 19.904	27.553 19.904 559.700
27.383 19.924 59.355	45.24	7.728 5.740 17.439	1.231 38.576 10.284	.908 .027 11.171	.488 2.464 10.731	17.439 1085.583 10.715	8.880 19.924 -4.176	.876 19.880 19.901	28.274 19.902 559.355
30.475 19.916 59.355	50.23	7.787 6.263 17.451	.928 38.253 10.417	.815 .027 11.166	.444 2.452 10.836	17.451 993.960 10.770	10.002 19.920 -3.853	.877 19.880 19.899	28.597 19.900 559.700
31.211 19.908 59.700	55.23	7.866 6.660 17.557	.930 37.656 10.513	.812 .027 11.151	.454 2.346 10.919	17.557 995.490 10.833	10.044 19.934 -3.256	.882 19.881 19.907	29.194 19.907 559.355
25.183 19.903 59.355	60.23	7.945 8.247 18.549	1.145 36.269 10.660	.984 .028 11.065	.586 1.298 11.025	18.605 1181.390 10.917	8.237 19.927 -1.669	.935 19.881 19.903	30.781 19.904 559.355
24.497 19.907 59.700	65.22	8.024 9.684 18.126	1.127 34.632 10.758	.953 .027 10.812	.601 1.739 10.920	18.164 1166.301 10.789	8.230 19.957 -.232	.913 19.885 19.920	32.218 19.921 559.700

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)1P	MN)2 TURN P)1P	MN)X,2 M)2 P)8P	MN)Y,2 DP)1,2 P)1NP	PT)2 V)2 P)3P	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	8.183 10.755 10.976	.926 33.566 10.071	.757 .225 10.515	.497 2.927 10.726	16.976 973.451 10.626	9.972 19.936 .840	.853 19.878 19.906	33.290 19.907 559.355
75.02	8.182 11.912 10.629	.820 32.424 10.461	.677 .224 10.155	.464 4.274 10.583	15.629 892.892 10.413	10.045 19.948 1.996	.785 19.908 19.927	34.446 19.928 559.700
80.01	8.261 11.404 13.264	.644 32.912 10.207	.534 .020 10.066	.359 6.639 10.251	13.264 717.270 10.035	10.036 19.936 1.486	.666 19.874 19.901	33.938 19.902 559.355
85.01	8.340 -1.511 11.260	.42 40.827 9.966	.393 .015 10.392	.151 8.643 9.939	11.260 479.356 9.770	9.969 19.936 -11.427	.566 19.882 19.908	21.023 19.909 559.700
90.01	8.419 -10.703 11.551	.448 30.019 9.810	.445 .013 10.930	.253 6.352 9.773	11.551 529.148 9.688	10.065 19.930 -25.619	.580 19.894 19.912	6.831 19.912 559.355
95.00	8.498 -9.294 13.174	.622 33.010 9.700	.605 .017 11.414	.142 6.729 9.712	13.174 594.560 9.786	10.150 19.917 -19.210	.662 19.867 19.891	13.240 19.892 559.700
100.00	8.577 -4.779 15.227	.779 49.095 9.633	.742 .022 11.693	.236 4.676 9.932	15.227 853.226 10.177	10.193 19.915 -14.695	.765 19.900 19.907	17.755 19.907 559.700

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.943 27.161 .831

CASCADE EXIT PARAMETERS
 BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.839	.430	15.549	9.335	559.355	1.178	.933

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.726	.427	15.125	10.133	559.355	1.142	.842	30.488

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TP/P	DF	DF/EQ	OV/Y	RN2	DPS/G1	DEV	TURN
BETA/C	A2/A1						
1.525	.831	.711	1.508	.353	1.342	1.211	.237
.855	.446	1.682	.595	1.190	.419	4.627	39.689
28.879	.463						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TP/P	DF	DF/EQ	OV/Y	RN2	DPS/G1	DEV	TURN
BETA/C	A2/A1						
1.764	.810	.645	1.414	.356	1.412	1.249	.267
.860	.511	1.852	.592	1.111	.512	7.954	36.362
22.540	.561						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

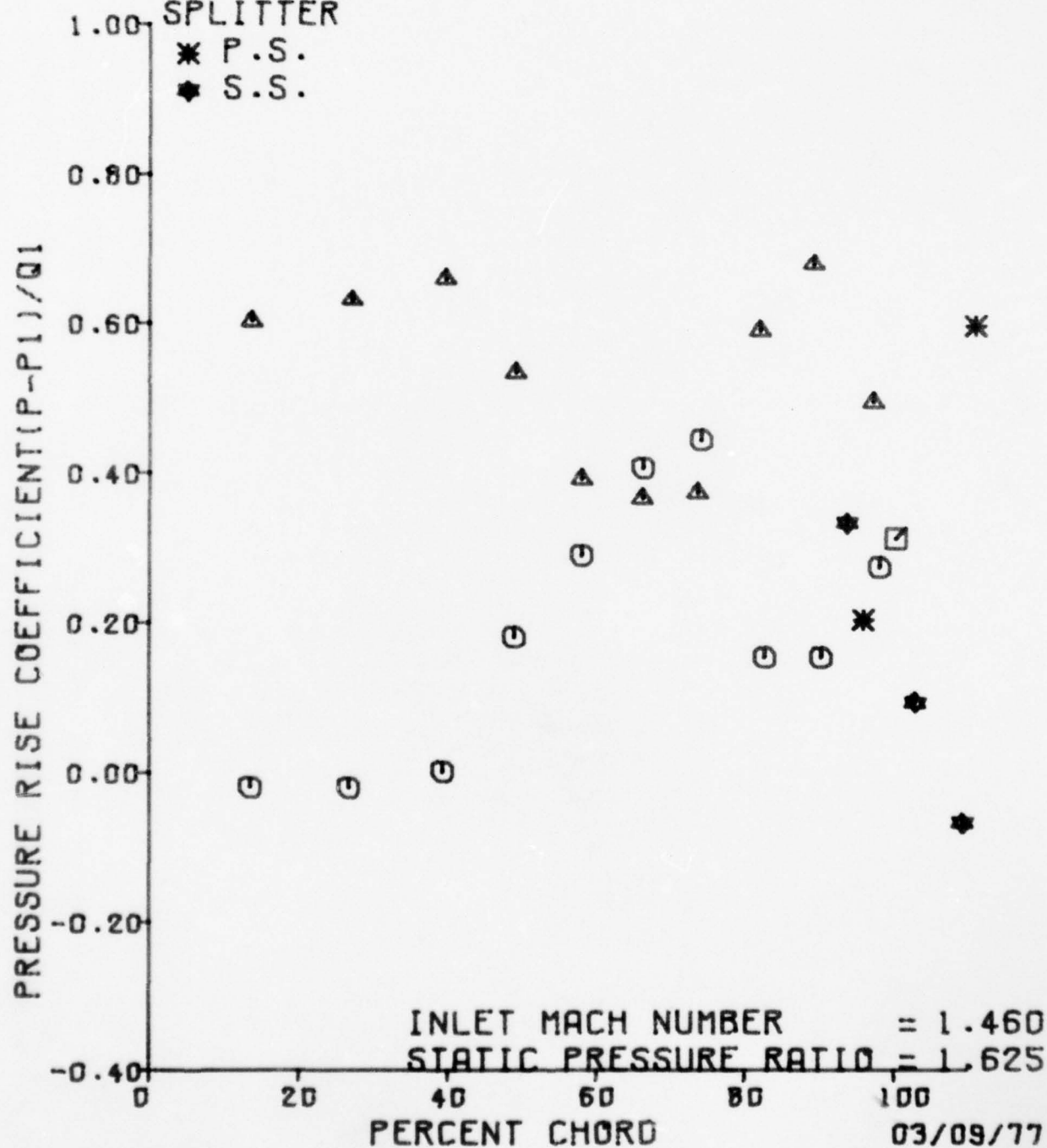
○ S.S.

◻ T.E.

SPLITTER

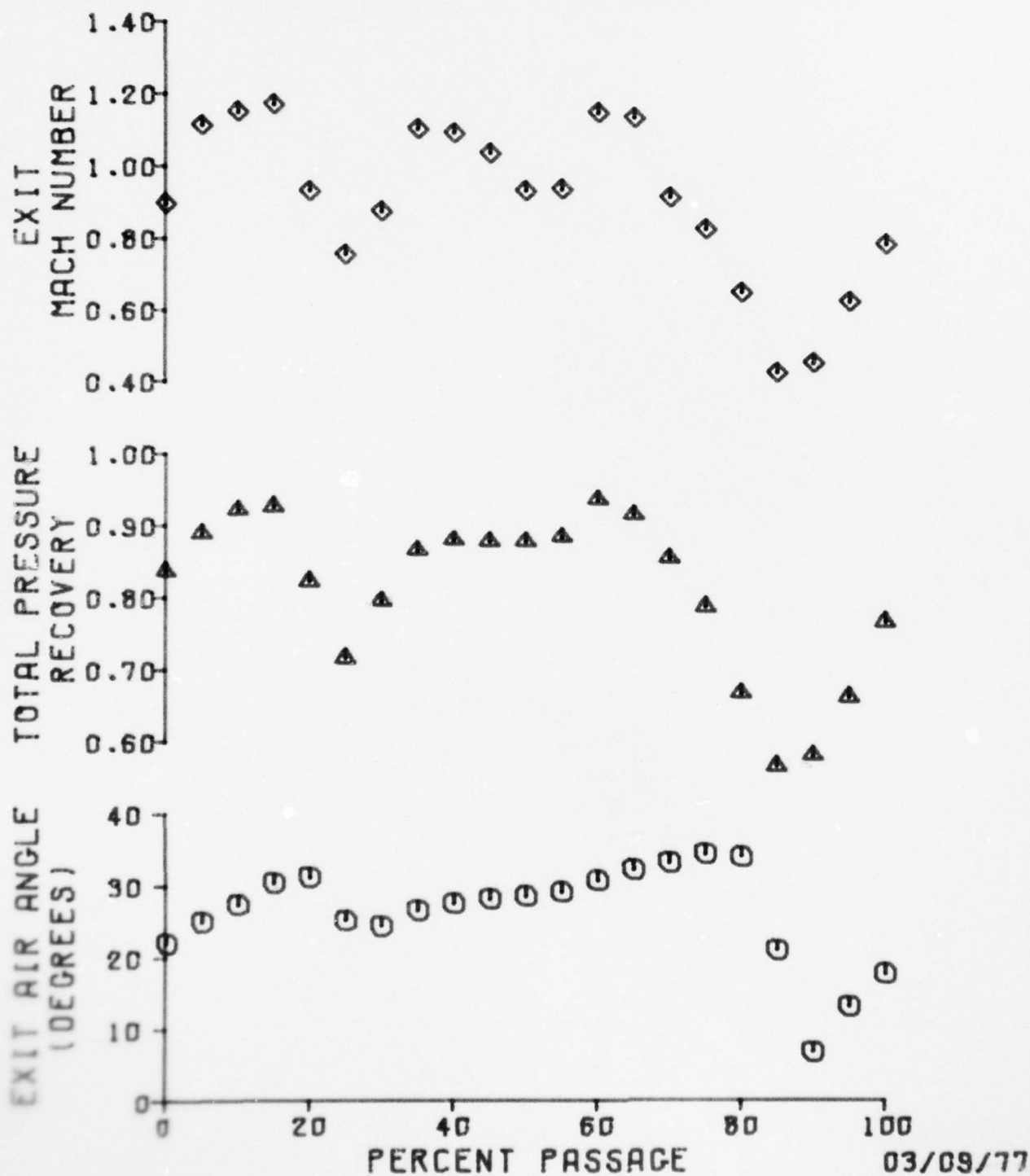
* P.S.

◆ S.S.

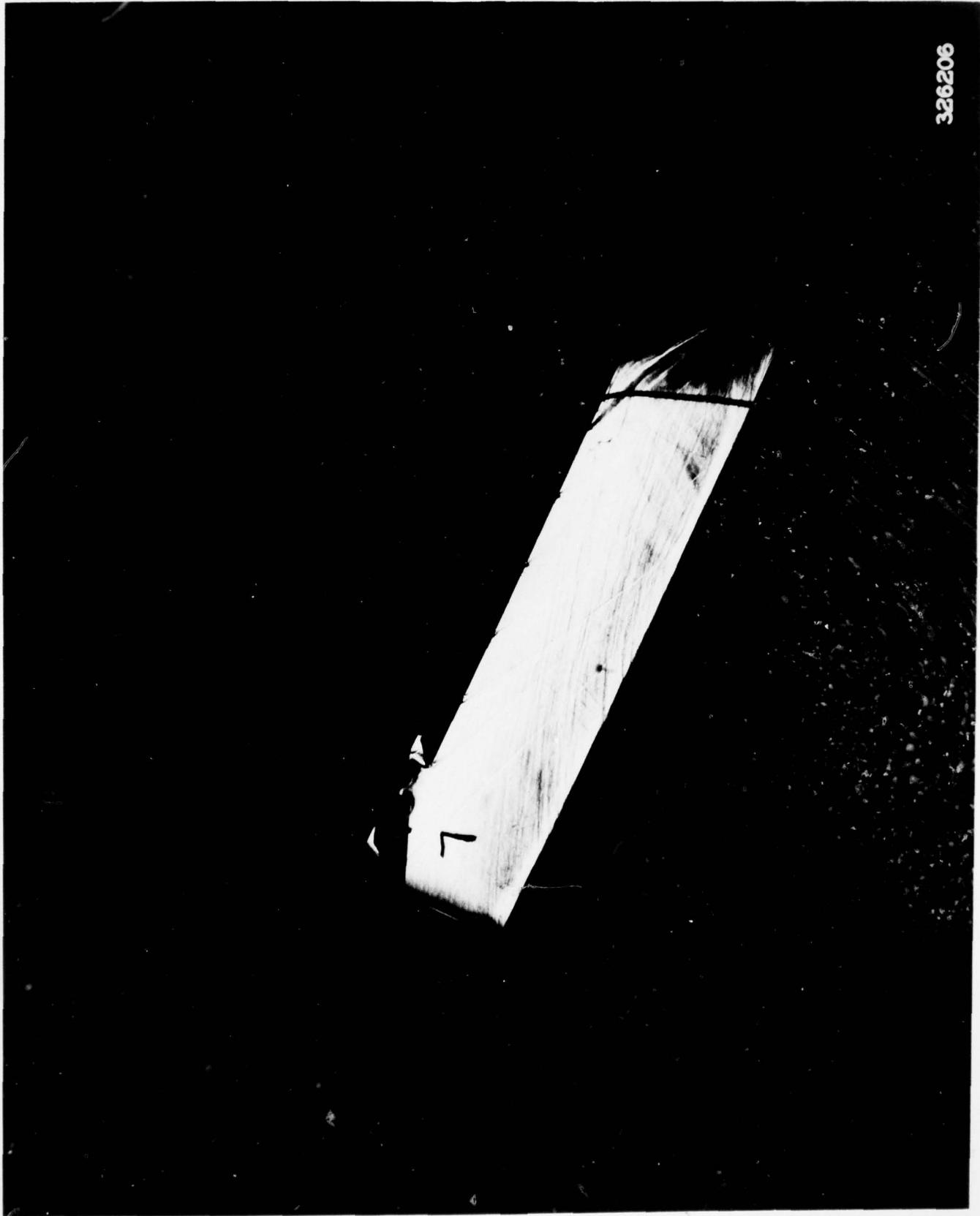


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.625



03/09/77



326206

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.625

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.547	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
6.572	1.503	57.550	24.330	559.700

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION + EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.260

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.924	19.939	19.943	19.920
11	13.632	6.627	10.894	10.767
13	10.362	10.392	11.160	5.580
15	11.772	10.700	11.398	5.759
17	10.501	14.458	10.322	7.343
19	12.549	11.843	9.107	8.308
21	19.869	10.153	9.083	9.261
23	9.604	14.459	10.567	9.558
25	9.528	11.244	11.808	7.147
27	9.882	6.830	12.015	8.439
29	9.666	6.835	10.464	9.254
31	9.675	14.468	9.569	19.925
33	9.806	9.560	9.565	2.301
35	9.653	9.807	9.558	2.681
37	9.648	9.738	9.553	1.725
39	9.739	14.454	9.440	1.785
41	10.196	10.563	9.441	1.619
43	19.923	14.461	10.016	8.608
45	4.938	19.895	11.497	6.550
47	19.904	19.911	19.919	5.934

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.155	.045	60%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
32.316	3.884	1.581	.235	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

MMJ0	PTJ0	TTJ0	MJ0	BETAJ0
1.588	19.899	559.720	9.818	65.670

CASCADE INLET CONDITIONS

MMJ1	PTJ1	TTJ1	BETAJ1	PJ1	MJ1	QJ1
1.460	19.898	559.700	66.850	5.744	.242	8.568
IJSS	IJML	MMX,1	MMY,1	TT/TJ1	PT/PJ1	NR/10**6
1.371	3.482	.574	1.342	1.426	3.464	1.439

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.604	33	9.806
25	9.528	35	9.653
27	9.682	37	9.648
29	9.866	39	9.739
31	9.675	41	10.196

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
9.711	.141	9.809	.203	1.066	1.691

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.569
		33	9.565
		35	9.558
		37	9.553
		39	9.440
		41	9.441

MEAN TRAILING EDGE PRESSURE (PSIA) 9.521 RMS DEVIATION .057

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.301 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.681 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.725 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.785 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.700 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.619 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.294 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.071

62581

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	OPS/Q1 (PS)	OPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.894	5.580	.601	-.019	.548	.280	13.69	13.45
13	11.150	5.580	.632	-.019	.561	.280	26.98	26.63
15	11.390	5.759	.660	.002	.573	.289	39.60	39.24
17	10.322	7.343	.534	.187	.519	.369	49.07	48.78
19	9.187	8.308	.393	.299	.458	.418	57.88	57.75
21	9.083	9.261	.390	.411	.456	.465	66.00	66.09
23	10.367	9.558	.503	.445	.531	.480	73.41	73.77
25	11.808	7.147	.708	.104	.593	.359	81.70	62.41
27	12.015	8.439	.732	.315	.604	.424	89.05	89.97
29	10.404	9.254	.551	.410	.526	.465	96.93	97.73
3	9.497	9.497	.438	.438	.477	.477	100.00	100.00

FC	FB)X	FC)Y	BETA)F	CD)1	CL)1	MO)LE	CP)LE
.364	-.298	.210	-30.160	-.016	.364	.131	36.065

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	OPS/Q1 (PS)	OPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	10.010	6.608	.499	.334	.503	.433	95.57	93.37
45	11.497	6.550	.671	.094	.578	.329	110.63	102.50
47		5.934		.022		.298		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)6P	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	8.996 -8.081 10.572	.829 44.397 10.257	.766 .000 11.901	.317 3.326 10.751	16.572 901.340 10.737	10.560 19.929 -9.997	.833 19.884 19.906	22.453 19.906 559.355
5.00	7.075 1.875 17.534	.895 42.441 10.404	.815 .027 11.921	.370 2.304 10.962	17.594 963.849 10.971	10.456 19.939 -8.041	.884 19.905 19.921	24.409 19.922 559.355
9.99	7.154 5.192 10.306	1.096 39.124 10.397	.970 .028 11.698	.510 1.574 11.126	18.324 1141.340 11.126	8.624 19.936 -4.724	.921 19.879 19.908	27.726 19.908 559.355
14.99	7.233 8.027 18.277	1.114 36.289 10.752	.959 .028 11.196	.566 1.593 11.043	18.306 1156.325 11.080	8.425 19.935 -1.889	.920 19.905 19.919	30.561 19.920 559.355
19.99	7.312 8.309 16.256	.831 36.007 10.569	.713 .026 10.929	.425 3.632 10.625	16.256 902.910 10.749	10.347 19.946 -1.607	.817 19.893 19.919	30.843 19.920 559.355
24.98	7.391 3.003 14.586	.705 41.313 10.366	.637 .023 11.184	.304 5.312 10.353	14.586 780.193 10.470	10.464 19.937 -6.913	.733 19.891 19.913	25.537 19.914 559.355
29.98	7.470 1.998 15.850	.798 42.318 10.253	.726 .023 11.442	.331 4.048 10.456	15.850 871.407 10.627	10.420 19.948 -7.918	.797 19.930 19.938	24.532 19.939 559.700

62581

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

ETA)2 T)0,A T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 OP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
2.453 9.906 9.355	35.84	7.558 3.547 17.139	.893 48.769 18.952	.799 .026 11.519	.391 2.748 10.738	17.159 958.812 10.849	10.257 19.946 -6.369	.862 19.913 19.928	26.081 19.929 559.700
4.409 9.922 9.355	40.84	7.629 4.738 17.427	.806 39.366 18.518	.805 .027 11.489	.415 2.471 10.907	17.427 973.751 10.935	10.237 19.951 -5.166	.876 19.912 19.930	27.284 19.931 559.355
7.726 9.908 9.355	45.84	7.708 5.341 17.449	.892 38.975 18.638	.788 .027 11.493	.417 2.450 11.043	17.449 960.328 11.009	10.412 19.955 -4.575	.877 19.919 19.936	27.875 19.937 559.355
0.561 9.920 9.355	50.83	7.787 5.933 17.528	.885 38.383 18.743	.778 .027 11.485	.422 2.370 11.149	17.528 953.898 11.086	10.537 19.952 -3.983	.881 19.915 19.933	28.467 19.933 559.700
2.843 9.920 9.355	55.83	7.865 6.463 17.609	.891 37.653 18.848	.779 .027 11.501	.432 2.229 11.256	17.669 959.600 11.176	10.552 19.952 -3.453	.888 19.905 19.928	28.997 19.928 559.355
0.537 9.914 9.355	60.83	7.943 7.953 18.517	1.087 36.351 11.007	.936 .028 11.465	.552 1.368 11.402	18.530 1133.455 11.305	8.822 19.952 -1.951	.931 19.908 19.929	30.499 19.930 559.355
1.532 9.939 9.700	65.82	8.024 9.346 18.200	.928 34.978 11.170	.788 .028 11.286	.490 1.698 11.365	18.200 994.326 11.256	10.431 19.938 -5.570	.915 19.879 19.908	31.880 19.908 559.700

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 P)10 P)11	BETA)2 PT)0,A TT)1
70.02	8.103 10.352 17.067	.844 33.954 11.127	.709 .925 11.050	.459 2.892 11.228	17.307 915.920 11.135	10.667 19.924 .446	.855 19.877 19.900	32.896 19.901 559.355
75.02	8.102 11.144 13.604	.753 33.172 10.979	.626 .823 10.809	.417 4.234 11.137	15.664 827.348 11.241	10.758 19.927 1.228	.787 19.890 19.908	33.678 19.909 559.010
80.01	8.251 11.444 13.474	.624 32.872 13.855	.517 .820 10.709	.349 5.924 11.022	13.974 696.562 10.846	10.752 19.931 1.528	.702 19.894 19.912	33.978 19.913 559.355
85.01	8.348 8.086 12.178	.441 35.230 10.775	.379 .815 10.857	.225 7.720 10.686	12.178 501.598 10.594	10.656 19.946 -1.830	.612 19.914 19.929	30.620 19.930 559.355
90.01	8.419 -11.224 11.738	.362 55.540 10.718	.355 .812 11.186	.071 8.158 10.542	11.736 414.619 10.498	10.713 19.944 -21.140	.589 19.892 19.917	11.310 19.918 559.355
95.00	8.498 -12.185 12.425	.464 54.501 10.476	.453 .814 11.492	.099 7.473 10.501	12.425 527.058 10.477	10.719 19.939 -20.101	.624 19.890 19.914	12.349 19.915 559.355
100.00	8.577 -0.692 13.631	.591 51.008 10.360	.566 .817 11.761	.161 6.248 10.515	13.651 662.335 10.550	10.780 19.949 -16.608	.686 19.892 19.920	15.842 19.921 559.700

62581

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SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.849 27.556 .835

CASCADE EXIT PARAMETERS
 BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	M)2/M)1
.755	.393	16.610	18.369	559.700	1.144	.915

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	MN)2	BETA)2
.666	.391	16.223	18.934	559.700	1.119	.772	30.418

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/G1	DEV	TURN
BETA)C	A)2/A)1						
1.805	.835	.849	1.464	.327	1.446	1.247	.232
.854	.514	1.845	.619	1.147	.540	5.022	39.295
20.528	.472						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/G1	DEV	TURN
BETA)C	A)2/A)1						
1.924	.815	.597	1.310	.329	1.494	1.274	.250
.839	.565	2.005	.517	1.071	.606	7.884	36.432
19.481	.511						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

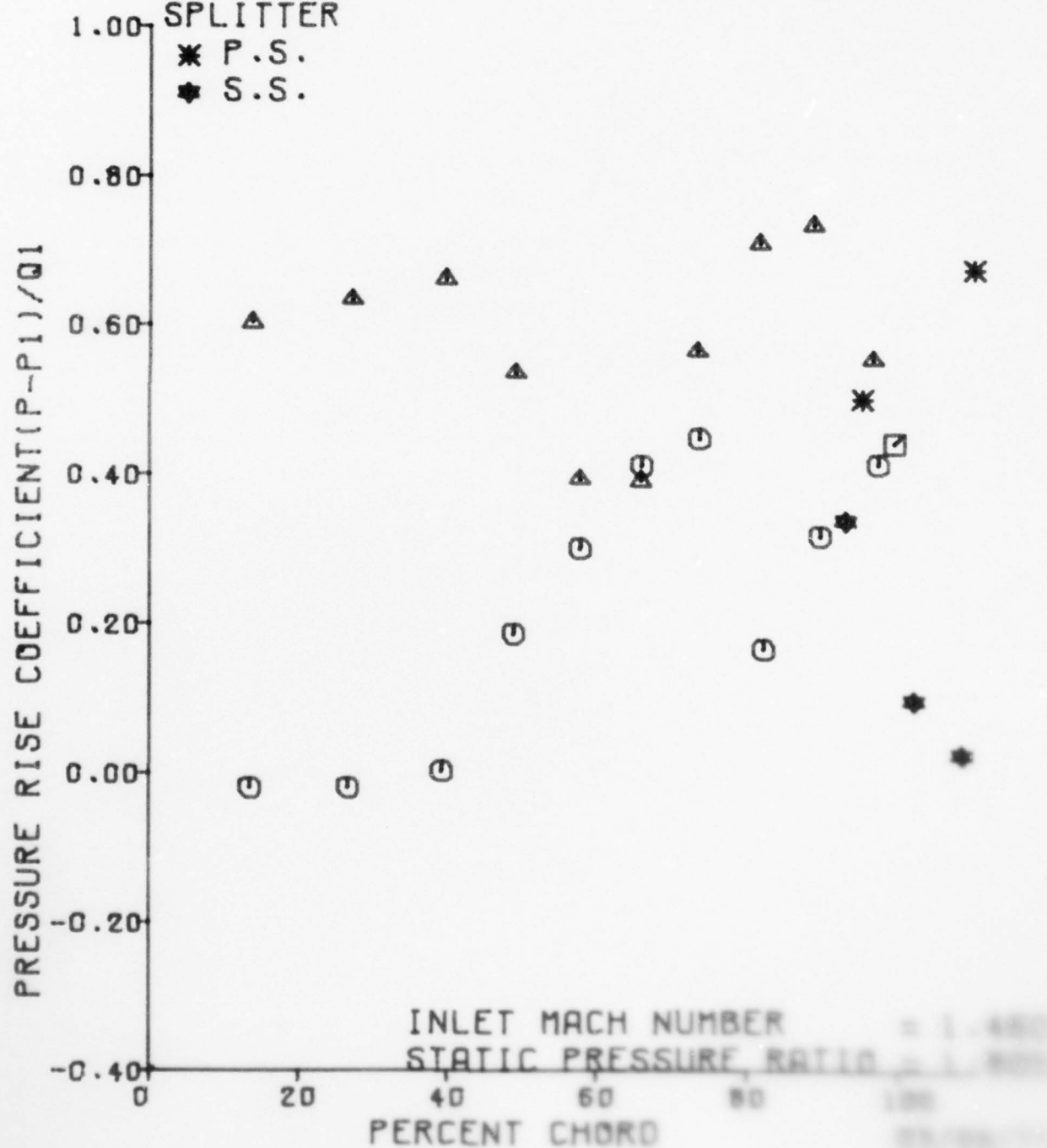
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◻ T.E.

SPLITTER

* P.S.

◆ S.S.



INLET MACH NUMBER

STATIC PRESSURE RATIO

PERCENT CHORD

AD-A043 860

GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER

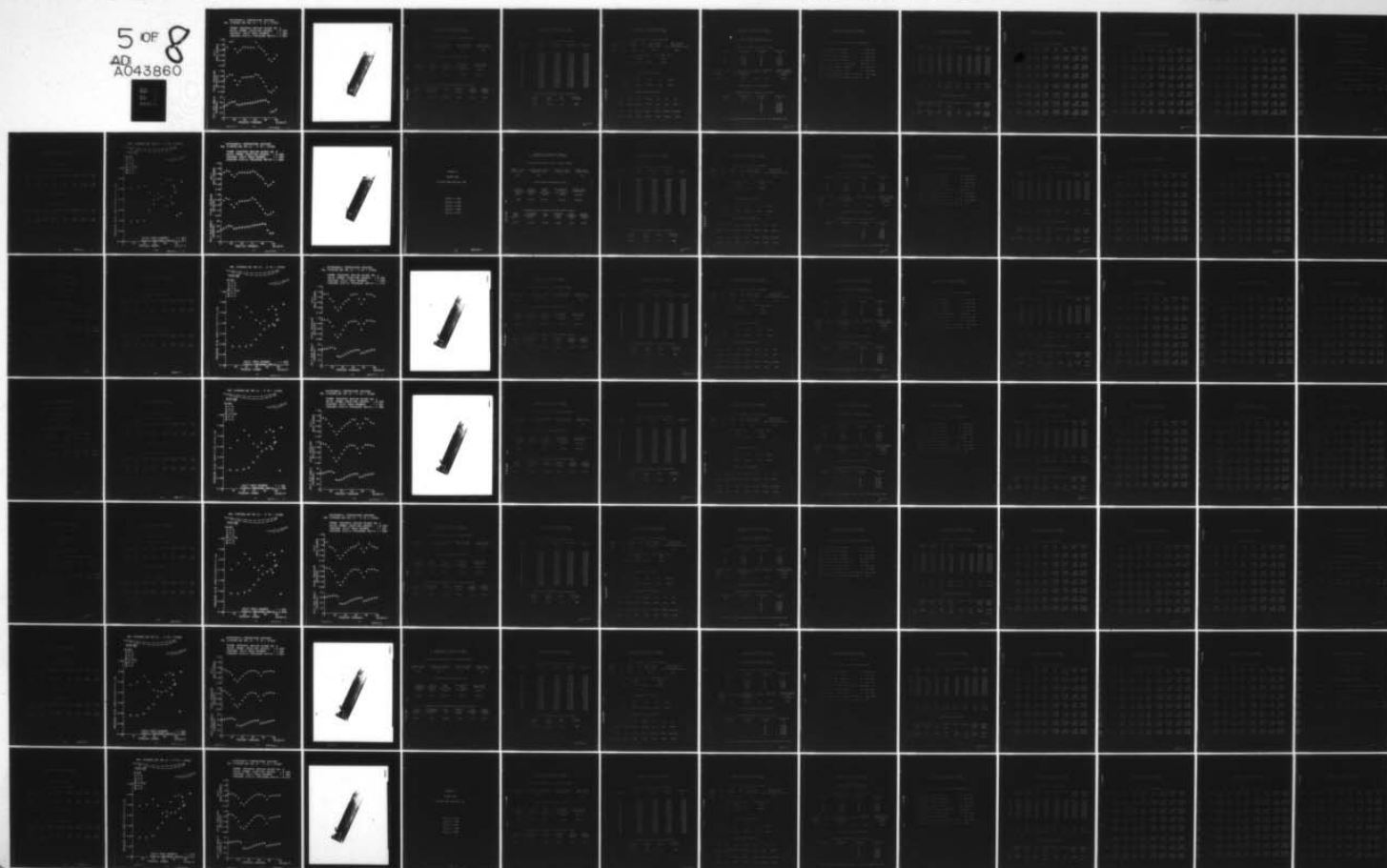
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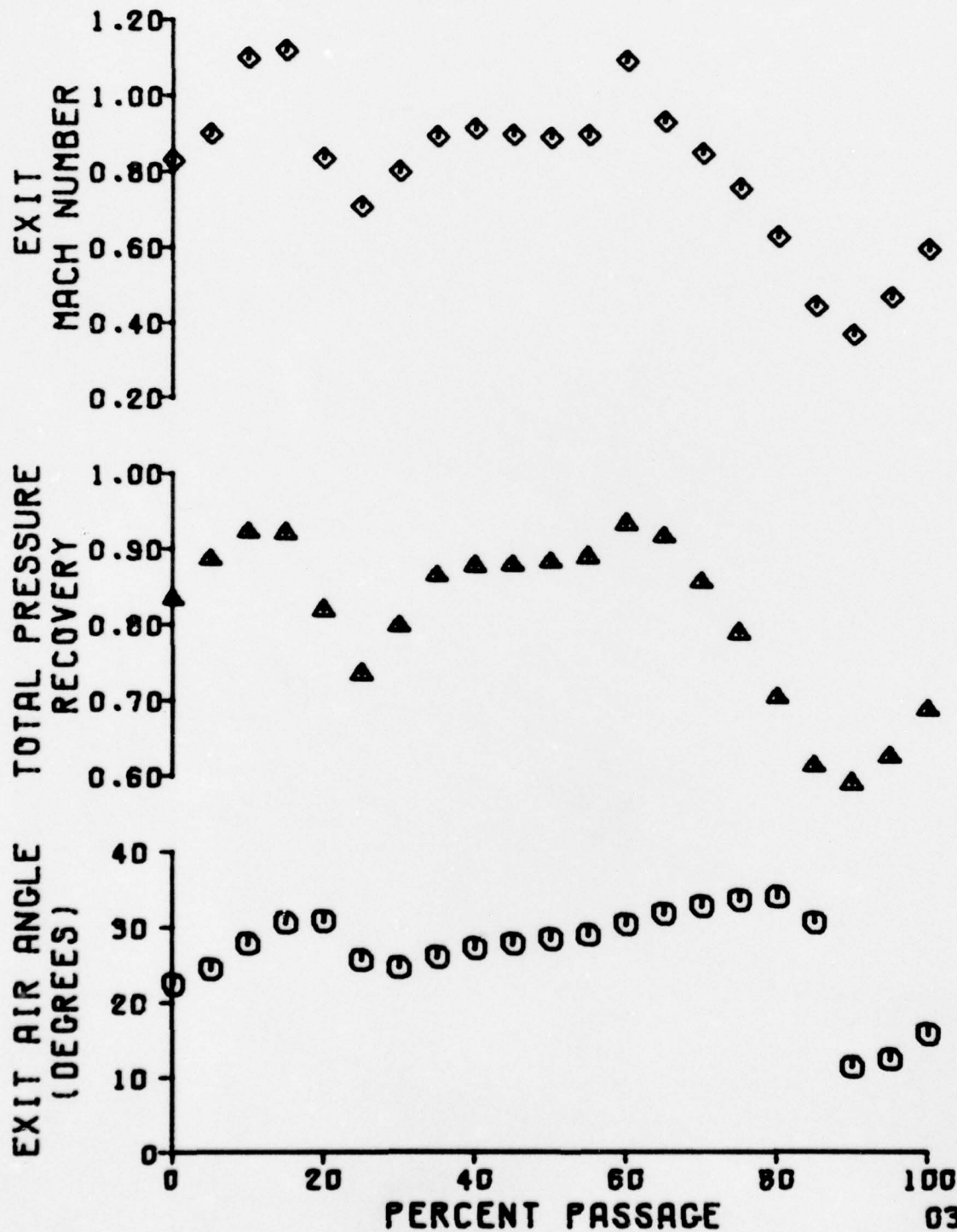
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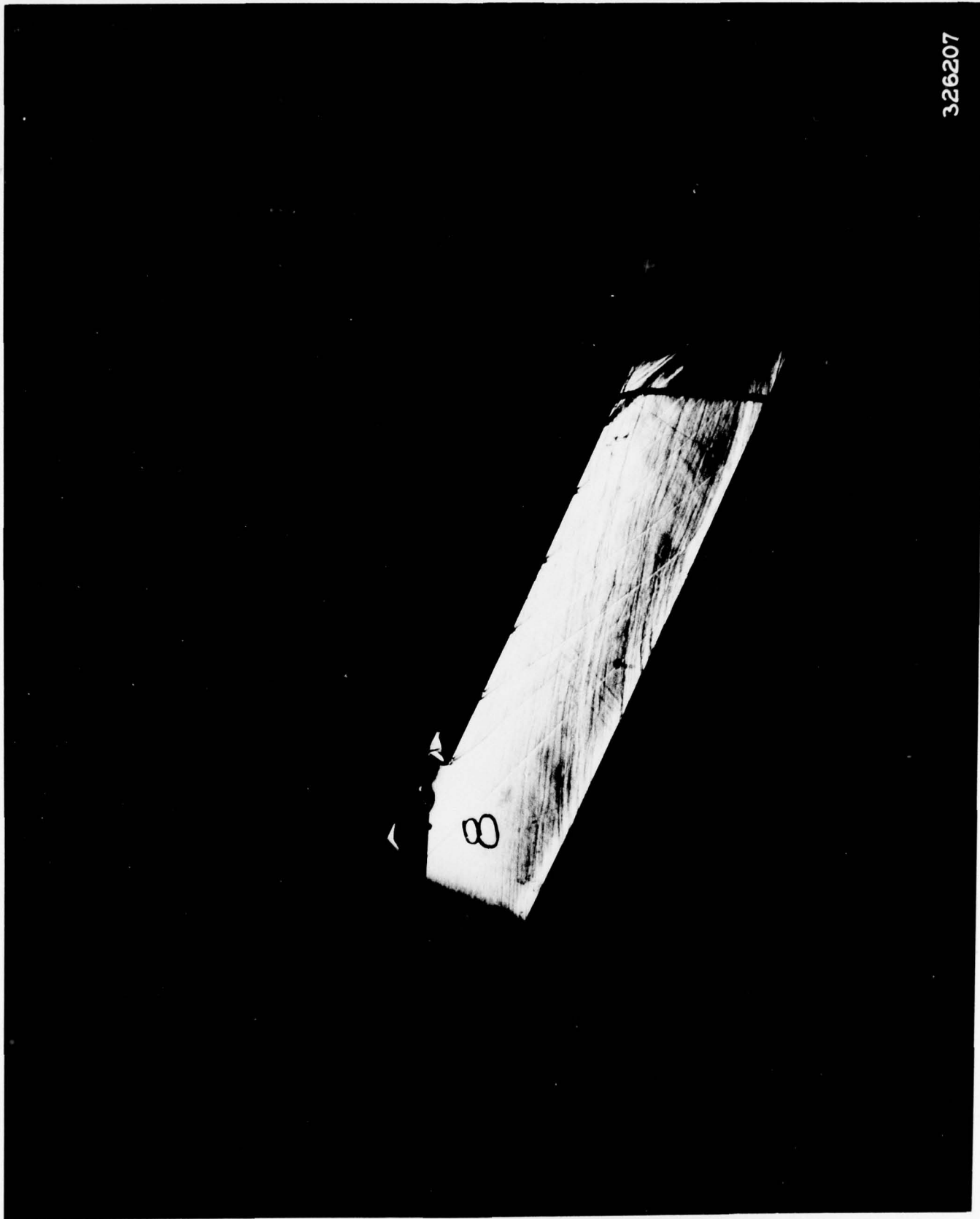


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.805



03/09/77



326207

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.809

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.813	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.369	1.502	57.550	24.330	559.010

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION + EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.944	19.947	19.932	19.930
11	13.163	6.614	10.903	10.495
13	11.064	10.462	11.159	5.621
15	11.944	10.743	11.361	5.656
17	11.179	14.466	10.285	7.399
19	11.222	11.835	9.123	6.425
21	19.856	10.142	10.173	9.316
23	10.336	14.466	11.709	9.600
25	10.264	11.031	12.371	8.094
27	10.584	6.701	12.483	9.607
29	10.521	6.712	11.095	10.289
31	10.390	14.476	10.438	19.955
33	10.560	10.227	10.428	2.259
35	10.380	10.417	10.420	2.731
37	10.378	10.419	10.417	1.762
39	10.419	14.464	10.466	1.860
41	10.807	11.187	10.458	1.658
43	19.941	14.470	11.446	8.569
45	4.915	19.900	12.141	6.547
47	19.932	19.923	19.937	6.917

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	60%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.884	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	NL	NL
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.911	559.010	9.029	65.670

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	G)1
1.460	19.910	559.010	65.850	5.747	.242	8.573
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.442

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.330	33	10.560
25	10.264	35	10.380
27	10.584	37	10.378
29	10.521	39	10.419
31	10.390	41	10.807

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
10.419	.118	10.509	.163	1.008	1.813

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.438
		33	10.428
		35	10.420
		37	10.417
		39	10.466
		41	10.458

MEAN TRAILING EDGE PRESSURE [PSIA] 10.438 RMS DEVIATION .019

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.259 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.731 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.762 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.660 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.658 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.297 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.072

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.983	5.621	.601	-.015	.548	.282	13.69	13.45
13	11.109	5.621	.631	-.015	.560	.282	26.98	26.63
15	11.361	5.656	.655	-.011	.571	.284	39.60	39.24
17	10.285	7.399	.529	.193	.517	.372	49.07	48.78
19	9.123	6.425	.394	.312	.458	.423	57.88	57.75
21	10.173	9.316	.510	.416	.511	.468	66.00	66.09
23	11.709	9.606	.695	.449	.588	.482	73.41	73.77
25	12.371	6.094	.773	.274	.621	.407	81.70	82.41
27	12.483	9.607	.786	.450	.627	.483	89.05	89.97
29	11.096	10.289	.624	.530	.557	.517	96.93	97.73
3	10.442	10.442	.548	.548	.524	.524	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.369	-.300	.210	-34.707	-.019	.368	.134	36.233

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.448	6.589	.665	.329	.575	.430	95.57	93.37
45	12.141	6.547	.746	.093	.610	.329	110.63	102.50
47		6.917		.136		.347		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YR	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DF)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	.76 .032 .73	.770 44.064 10.357	.710 .000 12.315	.298 3.317 11.255	16.593 843.422 11.252	11.213 19.935 -9.664	.833 19.895 19.915	22.786 19.915 559.010
5.00	7.075 2.295 17.693	.645 42.020 10.955	.767 .027 12.314	.355 2.217 11.482	17.693 915.866 11.446	11.092 19.966 -7.620	.889 19.917 19.941	24.830 19.942 559.010
9.99	7.154 4.974 18.371	.695 39.342 11.112	.794 .028 12.088	.414 1.539 11.590	18.371 963.255 11.603	10.918 19.953 -4.942	.923 19.915 19.933	27.508 19.934 559.010
14.99	7.233 7.852 18.859	.683 36.454 11.242	.753 .028 11.537	.448 1.841 11.453	18.069 953.310 11.533	10.862 19.945 -2.054	.908 19.882 19.913	30.396 19.913 559.010
19.99	7.312 7.357 16.072	.751 35.959 11.190	.651 .023 11.553	.374 3.638 11.146	16.072 825.504 11.256	11.052 19.953 -2.559	.807 19.921 19.937	29.891 19.937 559.355
24.98	7.391 2.737 15.037	.678 41.509 10.958	.613 .023 11.791	.289 4.823 11.005	15.087 751.515 11.076	11.093 19.950 -7.209	.758 19.938 19.943	25.241 19.944 559.010
29.98	7.470 2.951 16.433	.776 41.355 10.394	.700 .023 11.942	.334 3.477 11.122	16.433 849.499 11.170	11.039 19.940 -6.965	.825 19.916 19.927	25.485 19.928 559.355

62581

275

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
12 A 1									
86 15 10	35.84	7.558 4.388 17.265	.833 40.010 10.959	.743 .826 11.922	.376 2.645 11.283	17.265 904.554 11.322	10.957 19.930 -5.610	.867 19.905 19.917	26.840 19.918 559.010
30 42 10	40.84	7.629 4.923 17.420	.838 39.393 11.044	.744 .827 11.915	.387 2.490 11.394	17.420 909.812 11.387	10.992 19.953 -4.993	.875 19.908 19.930	27.457 19.930 559.010
28 34 10	45.84	7.708 5.518 17.469	.838 38.798 11.115	.740 .827 11.885	.394 2.441 11.467	17.469 909.735 11.417	11.025 19.939 -4.398	.877 19.884 19.911	28.052 19.911 559.010
96 13 10	50.83	7.787 5.939 17.562	.837 38.377 11.194	.736 .827 11.893	.399 2.348 11.583	17.562 908.501 11.503	11.098 19.934 -3.977	.882 19.885 19.909	28.473 19.909 559.010
91 37 55	55.83	7.865 6.565 17.771	.844 37.731 11.309	.737 .827 11.907	.411 2.139 11.705	17.771 915.032 11.601	11.150 19.966 -3.331	.893 19.911 19.938	29.119 19.939 559.010
41 44 10	60.83	7.945 7.766 18.504	.895 36.550 11.444	.773 .828 11.874	.452 1.356 11.624	18.554 963.255 11.707	11.026 19.956 -2.150	.932 19.900 19.927	30.300 19.928 559.010
85 28 55	65.82	8.024 9.230 17.923	.851 35.086 11.586	.723 .827 11.711	.448 1.987 11.769	17.923 921.296 11.674	11.169 19.955 -6.686	.900 19.908 19.931	31.764 19.931 559.010

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 OF)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	8.123	.763	.644	.408	16.704	11.362	.839	32.359
	9.825	34.491	.025	3.206	636.791	19.936	19.892	19.914
	16.764	11.555	11.568	11.676	11.621	-.091	19.913	559.010
75.02	8.182	.685	.574	.373	15.608	11.404	.784	33.033
	16.499	33.817	.022	4.302	758.919	19.938	19.903	19.920
	15.608	11.464	11.393	11.667	11.631	.583	19.920	559.355
80.01	8.261	.591	.487	.334	14.373	11.351	.722	34.441
	11.987	32.409	.019	5.537	661.870	19.958	19.915	19.937
	14.373	11.455	11.275	11.527	11.523	1.991	19.936	559.010
85.01	8.340	.426	.354	.237	12.779	11.279	.642	33.859
	11.325	32.991	.015	7.132	485.062	19.958	19.903	19.931
	12.779	11.429	11.367	11.293	11.316	1.409	19.930	559.010
90.01	8.419	.334	.310	.124	12.226	11.318	.614	21.857
	-.677	44.993	.012	7.684	382.858	19.951	19.900	19.925
	12.226	11.296	11.529	11.172	11.287	-10.593	19.925	559.010
95.00	8.498	.387	.372	.106	12.538	11.308	.630	15.889
	-6.645	50.961	.012	7.372	441.910	19.950	19.915	19.932
	12.538	11.154	11.719	11.163	11.303	-18.561	19.931	559.010
100.00	8.577	.480	.461	.135	13.268	11.332	.666	16.376
	-6.153	50.474	.015	6.642	544.013	19.958	19.919	19.939
	13.268	11.064	11.989	11.217	11.219	-16.074	19.938	558.666

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.770 28.115 .439

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 M)2/M)1

.573 .363 16.706 11.291 559.010 1.118 .894

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 MN)2 BETA)2

.616 .360 16.375 11.664 559.010 1.102 .713 30.335

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1 TLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.955	.839	.595	1.335	.305	1.541	1.275	.226
.853	.573	2.017	.639	1.102	.647	5.582	38.734
23.455	.486						

OVERALL PERFORMANCE

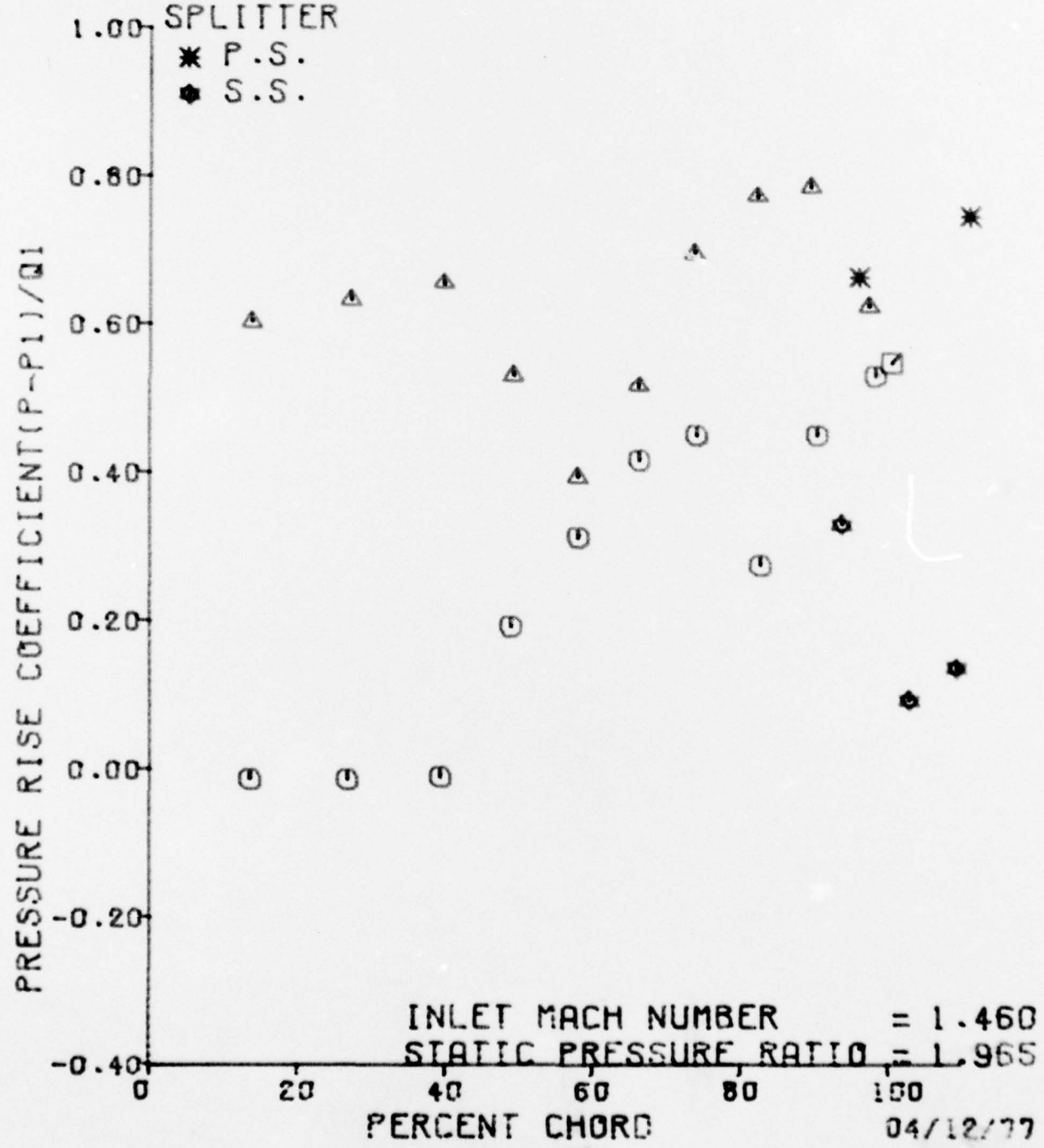
MIXED EXIT CONDITIONS

P)2/P)1 TLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
2.030	.622	.556	1.221	.305	1.566	1.294	.250
.857	.512	2.159	.639	1.036	.690	7.801	36.515
15.181	.523						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

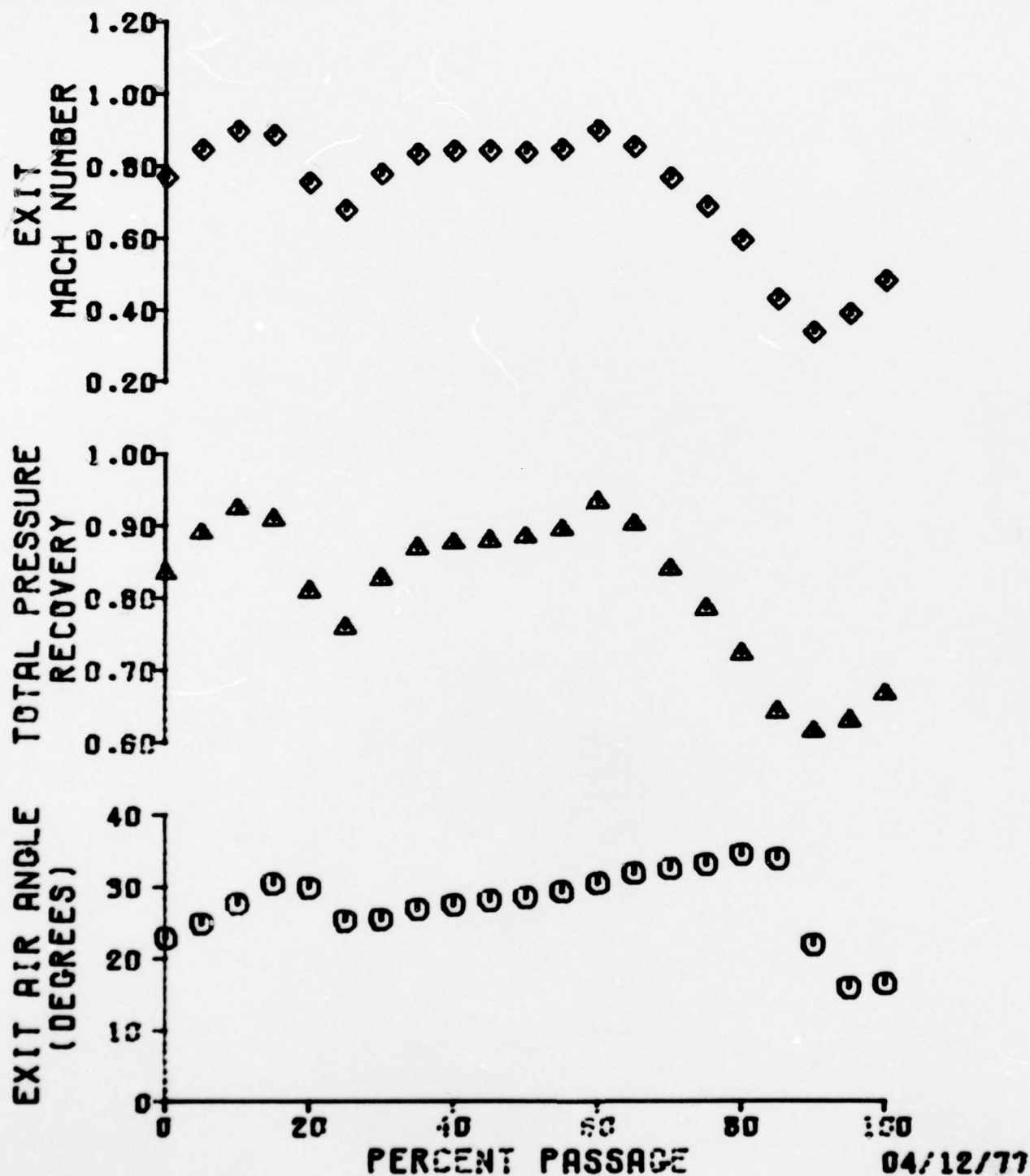


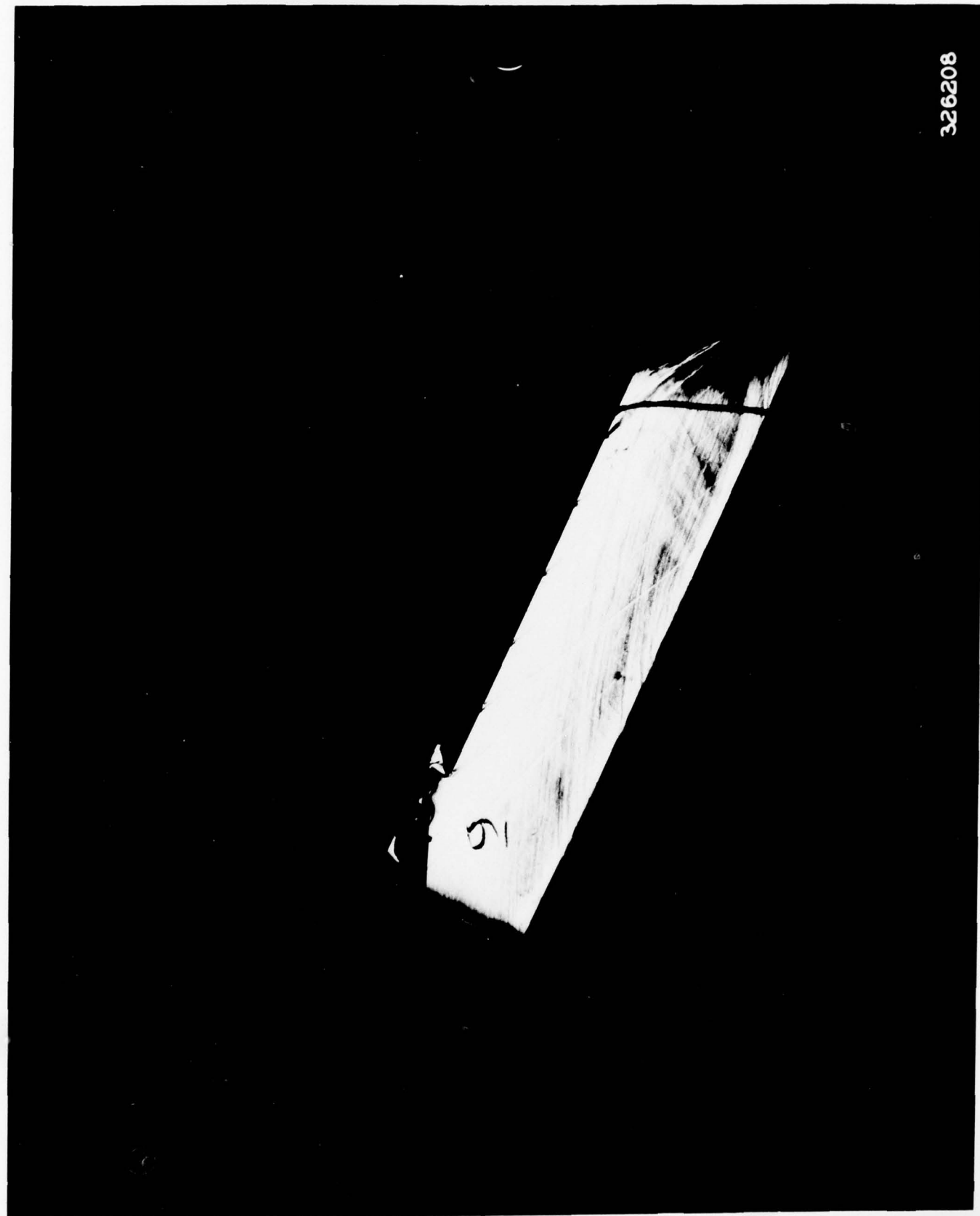
- BLADE
- ▲ P.S.
 - S.S.
 - T.E.
- SPLITTER
- * P.S.
 - ◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 5
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.965





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CASCADE INLET SCHLIEREN - $MN)1 = 1.46$, $P)2/P)1 = 1.965$

APPENDIX G

CASCADE DATA

SPLITTER VANE POSITION = 48%

$$P)_2/P)_1 = 1.718$$

$$P)_2/P)_1 = 1.786$$

$$P)_2/P)_1 = 1.836$$

$$P)_2/P)_1 = 1.964$$

$$P)_2/P)_1 = 2.013$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.710	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.502	58.060	24.316	563.493

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.167	43.102	1.460	1.000	1.059


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.898	19.902	19.922	19.925
11	18.600	8.614	8.523	1.781
13	11.274	8.245	10.026	5.342
15	11.590	9.231	11.784	5.384
17	11.564	14.530	10.971	5.576
19	11.422	11.033	9.648	6.491
21	19.888	10.291	9.130	7.269
23	9.593	14.532	9.517	8.181
25	9.753	10.292	11.424	8.744
27	10.080	9.554	11.920	9.038
29	10.011	10.056	10.372	9.643
31	9.738	14.542	9.772	10.985
33	10.078	10.065	9.770	2.297
35	9.768	10.788	9.764	2.697
37	9.667	9.910	9.761	1.669
39	9.907	14.526	9.815	1.679
41	10.318	10.701	9.812	1.833
43	19.942	14.534	11.416	8.851
45	5.023	19.990	12.302	2.199
47	19.940	19.930	19.955	5.253

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	48%



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.381	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	NL	NL
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.909	563.493	8.992	65.684

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	19.908	563.493	66.850	5.742	.241	8.572
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.426	3.467	1.427

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.593	33	10.078
25	9.753	35	9.768
27	10.089	37	9.667
29	10.011	39	9.907
31	9.738	41	10.318

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1)
9.837	.184	9.947	.231	1.056	1.713

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.772
		33	9.770
		35	9.764
		37	9.761
		39	9.815
		41	9.812

MEAN TRAILING EDGE PRESSURE [PSIA] 9.782 RMS DEVIATION .023

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.097 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.697 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.669 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.679 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.245 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.833 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.052 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.318 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.077

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.503	5.342	.322	-.047	.427	.268	13.69	13.45
13	10.226	5.342	.500	-.047	.504	.268	26.98	26.63
15	11.784	5.384	.705	-.042	.592	.270	39.60	39.24
17	12.971	5.576	.510	-.019	.551	.280	49.07	48.78
19	9.848	5.491	.456	.087	.485	.326	57.88	57.75
11	9.130	7.269	.395	.178	.459	.365	66.00	66.09
13	9.517	8.181	.440	.284	.478	.411	73.41	73.77
15	11.424	8.744	.663	.350	.574	.439	81.70	82.41
17	11.900	9.038	.718	.384	.598	.454	89.05	89.97
19	10.572	9.643	.563	.455	.531	.484	96.93	97.73
0	9.788	9.788	.472	.472	.492	.492	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.388	-.301	.211	-34.957	-.017	.367	.149	42.544

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.416	8.851	.562	.363	.573	.445	95.57	93.37
45	12.302		.765		.618		110.63	
7		5.253		-.057		.264		109.00



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 P)11	BETA)2 PT)0,4 TT)1
.20	6.284 7.564 19.192	1.112 36.752 11.299	.962 .700 11.752	.558 .568 11.630	19.220 1156.317 11.504	8.872 19.985 -1.832	.965 19.896 19.940	32.008 19.943 563.493
5.00	6.363 8.308 19.216	1.113 35.918 11.412	.955 .729 11.551	.572 .562 11.669	19.246 1159.664 11.483	8.865 19.928 -1.208	.967 19.850 19.888	32.932 19.889 563.493
9.99	6.442 9.545 19.106	1.112 34.771 11.474	.942 .709 11.437	.591 .773 11.646	19.134 1158.514 11.426	8.829 19.976 .149	.961 19.940 19.957	32.079 19.958 563.493
4.99	6.521 11.157 18.339	.933 33.159 11.451	.776 .728 11.893	.518 1.569 11.501	18.339 1201.861 11.238	10.457 19.975 1.751	.921 19.919 19.946	33.691 19.947 563.493
9.99	6.620 12.109 16.749	.834 32.117 11.291	.685 .725 10.823	.475 3.159 11.149	16.749 978.765 10.891	10.623 19.925 2.793	.841 19.874 19.899	34.733 19.900 563.493
4.98	6.679 9.297 13.647	.624 35.219 10.988	.513 .721 10.918	.318 6.260 10.676	13.647 678.091 10.551	10.669 19.933 -1.109	.686 19.896 19.913	31.831 19.913 563.493
9.98	6.758 -5.219 12.577	.491 49.535 12.603	.468 .716 11.429	.146 7.331 10.457	12.577 557.500 10.365	10.669 20.007 -14.615	.632 19.952 19.979	17.315 19.979 563.838

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

Q	PERCT	Y DEV PT1YP	MN12 TURN PT1P	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 P110 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
8		6.838	.519	.593	.177	13.828	10.678	.694	16.605
3	5.24	-5.929	59.245	.218	6.088	594.443	19.922	19.867	19.894
3		13.828	10.366	11.785	10.363	10.319	-15.325	19.894	563.493
2		6.917	.747	.768	.239	15.511	10.711	.779	18.643
3	0.24	-3.891	48.227	.322	4.397	824.341	19.985	19.952	19.969
3		15.511	10.268	12.360	10.516	10.598	-13.297	19.968	563.838
9		6.996	.849	.791	.310	17.067	10.650	.857	21.414
3	5.24	-1.120	45.436	.026	2.841	923.787	19.982	19.989	19.946
3		17.067	10.351	12.168	10.826	10.984	-10.516	19.945	563.838
1		7.075	.925	.844	.380	18.182	10.455	.913	24.221
3	0.23	1.687	42.629	.028	1.726	994.968	19.994	19.961	19.978
3		18.182	10.508	12.163	11.101	11.263	-7.709	19.977	563.838
3		7.154	1.382	.966	.487	18.648	8.933	.937	26.759
3	5.23	4.225	40.091	.029	1.260	1133.076	19.936	19.906	19.921
3		18.637	10.817	12.032	11.244	11.354	-5.171	19.920	563.838
1		7.233	1.098	.969	.516	18.783	8.818	.944	28.030
3	0.23	5.496	38.820	.029	1.125	1146.858	19.886	19.842	19.864
3		18.764	10.958	11.891	11.299	11.359	-3.900	19.863	563.493
5		7.312	1.114	.957	.563	18.760	8.629	.942	29.771
3	3.02	7.237	37.079	.029	1.148	1160.611	19.939	19.881	19.910
3		18.731	11.016	11.537	11.231	11.247	-2.159	19.909	563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PRCT	Y DEV PT1/P	PN12 TURN P1/P	MN1Y,2 M12 P1/P	MN1Y,2 DP11,2 P1/P	PT12 V12 P1/P	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10,4 PT11
73.22	7.391 7.477 17.793	.926 36.839 10.956	.802 .028 11.338	.463 2.115 10.983	17.793 995.321 11.004	10.227 19.934 -1.929	.894 19.892 19.912	30.011 19.913 563.838
5.00	7.470 1.151 15.534	.749 43.155 10.561	.685 .025 11.789	.301 4.274 10.884	15.534 825.897 10.776	10.781 19.945 -8.245	.785 19.893 19.919	23.685 19.919 563.838
3.21	7.549 2.039 17.916	.918 42.277 10.571	.835 .026 12.022	.382 1.992 10.879	17.916 987.878 11.093	10.398 19.954 -7.357	.902 19.863 19.908	24.573 19.909 563.838
1.21	7.528 4.459 18.947	1.115 39.857 10.791	.994 .329 11.997	.506 .930 11.293	18.978 1161.065 11.407	8.724 19.953 -4.947	.953 19.935 19.944	26.993 19.944 563.838
0.21	7.707 5.935 19.086	1.107 38.381 11.058	.973 .029 11.912	.528 .878 11.504	19.030 1154.198 11.491	8.838 19.957 -3.461	.956 19.909 19.932	26.469 19.933 563.838
0.00	7.786 7.074 18.899	1.387 37.242 11.194	.945 .029 11.751	.537 .995 11.562	18.913 1137.860 11.477	8.997 19.919 -2.322	.950 19.860 19.889	29.608 19.889 563.838
0.00	7.865 8.017 18.647	1.027 36.299 11.299	.885 .029 11.615	.522 1.261 11.588	18.647 1086.109 11.442	9.541 19.963 -1.389	.937 19.918 19.940	30.551 19.940 563.493

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 P112/PT11

.952 27.290 .888

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 M12/M11

.846 .437 17.682 9.869 563.493 1.181 1.019

MIXED EXIT CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 MN12 BETA12

.758 .434 17.345 10.550 563.493 1.153 .874 29.757

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EG	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.719	.888	.718	1.620	.357	1.423	1.228	.157
.037	.439	1.667	.591	1.263	.481	4.756	39.560
34.406	.434						

OVERALL PERFORMANCE

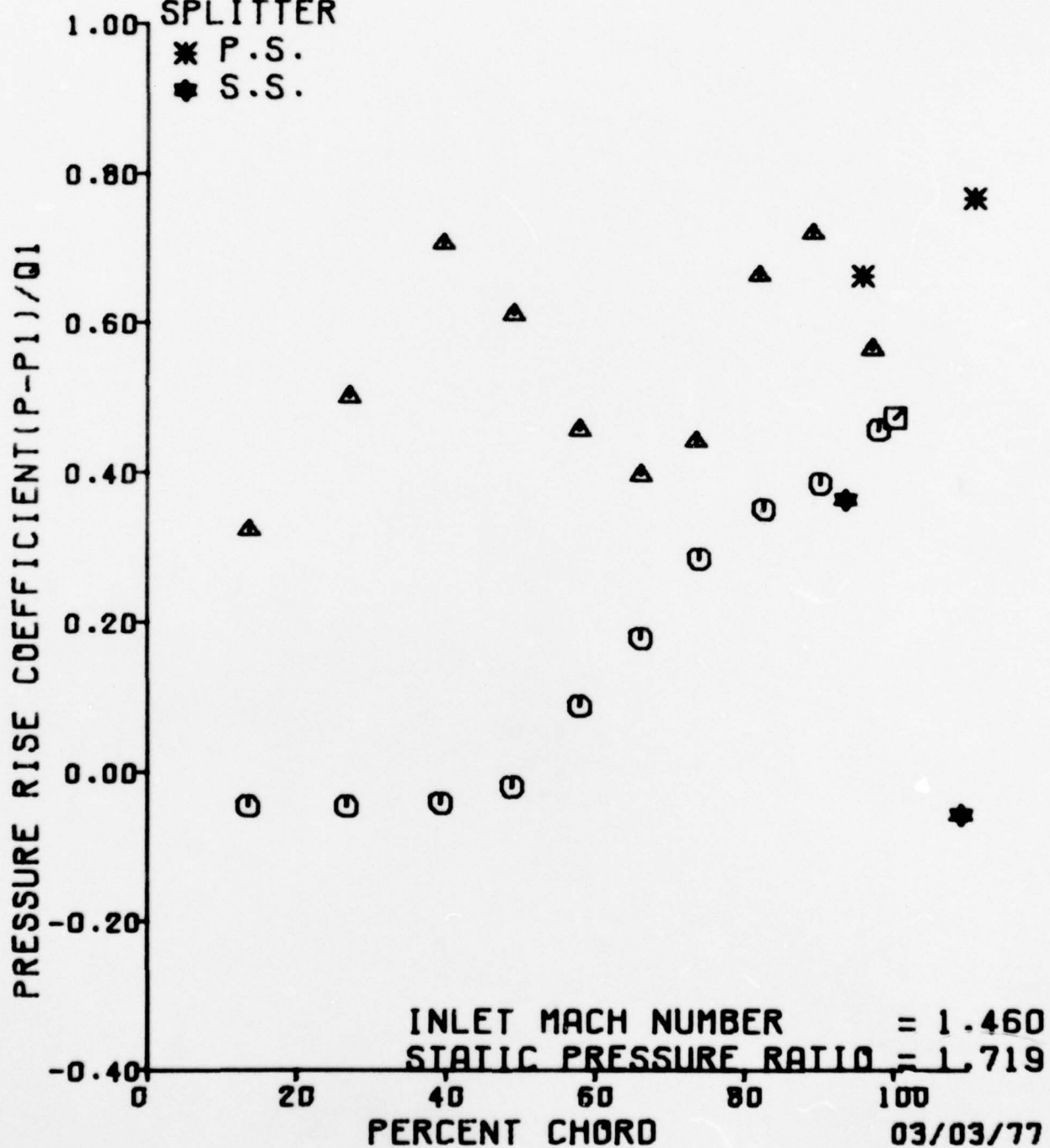
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EG	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.837	.871	.666	1.470	.359	1.485	1.238	.181
.041	.490	1.795	.589	1.202	.561	7.223	37.093
31.618	.458						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

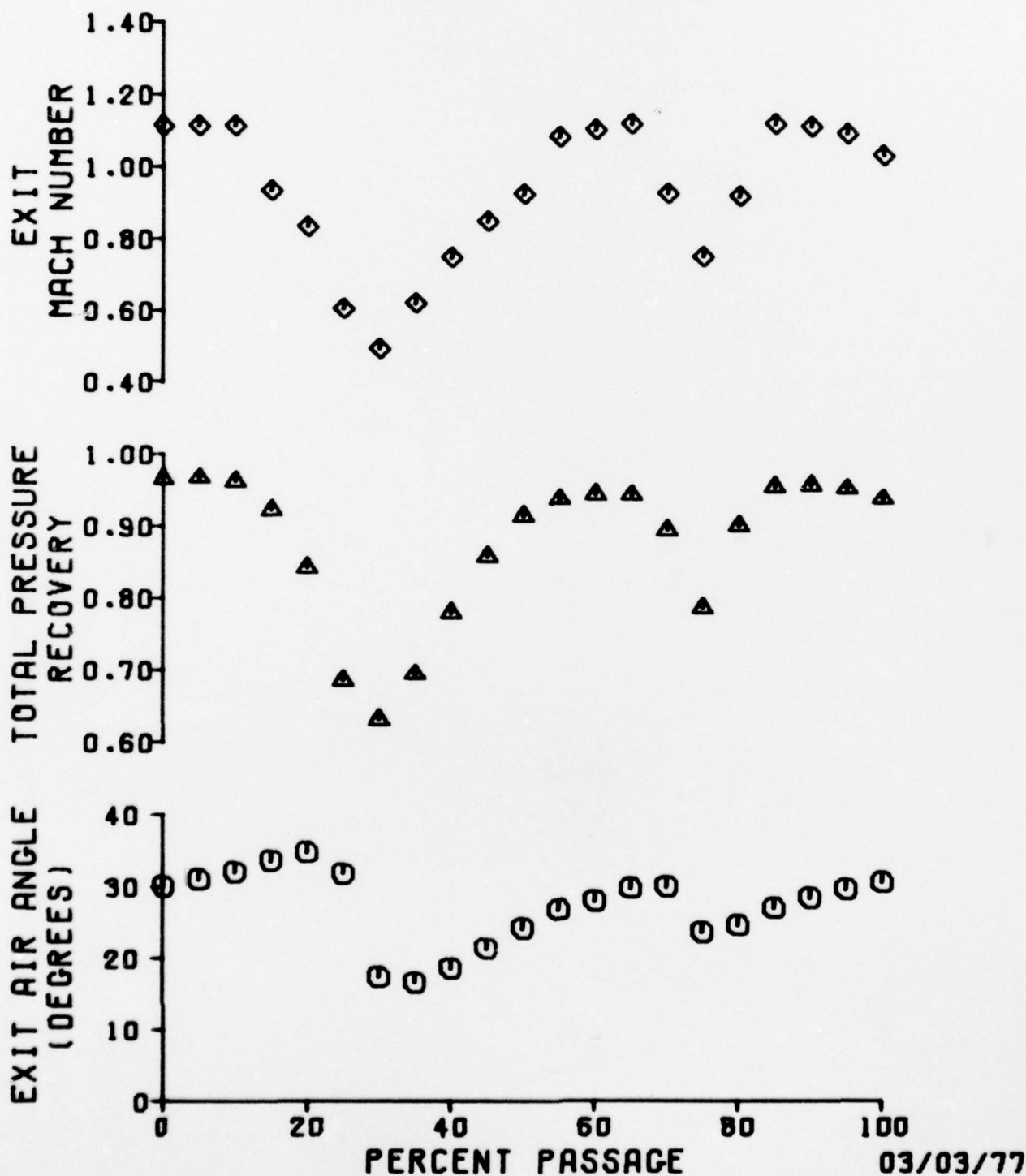


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.719



03/03/77



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CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.719

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.752	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG. R)
7.868	1.501	58.050	24.310	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION + EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.159	43.093	1.461	1.000	1.059

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.962	19.944	19.931	19.960
11	18.417	6.638	8.938	1.790
13	11.335	8.382	10.163	5.355
15	11.684	9.522	11.837	5.505
17	11.634	14.524	10.983	5.764
19	11.476	11.160	9.662	6.656
21	10.875	12.293	9.175	7.540
23	9.758	14.525	9.772	8.437
25	9.885	10.291	11.580	8.889
27	12.207	9.639	11.985	9.235
29	12.117	12.191	12.691	9.813
31	9.885	14.538	9.953	19.921
33	10.210	10.218	9.942	2.085
35	9.890	10.894	9.937	2.737
37	9.817	10.041	9.937	1.682
39	12.839	14.521	9.979	1.688
41	12.410	10.798	9.972	1.850
43	19.943	14.529	11.577	8.852
45	5.023	10.909	12.340	2.197
47	19.927	19.948	19.965	5.347

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	48%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MA10	PT10	TT10	M10	BETA10
1.500	19.921	563.838	8.995	65.690

CASCADE INLET CONDITIONS

MA11	PT11	TT11	BETA11	P11	M11	Q11
1.461	19.921	563.838	66.850	5.744	.241	8.577
ISS	IML	MN1Y,1	MN1Y,1	TI/T11	PT/P11	NR/10**6
1.371	3.482	.574	1.343	1.427	3.468	1.427

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.758	33	10.210
25	9.885	35	9.899
27	10.227	37	9.817
29	10.117	39	10.039
31	9.885	41	10.419

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.978	.155	10.077	.217	1.045	1.736

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.953
		33	9.942
		35	9.937
		37	9.937
		39	9.979
		41	9.972

MEAN TRAILING EDGE PRESSURE (PSIA) 9.953 RMS DEVIATION .017

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.985 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.737 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.682 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.688 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.850 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.061 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.342 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.083

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
1	8.938	8.358	.372	-.045	.449	.269	13.69	13.45
3	10.163	8.358	.515	-.045	.510	.269	26.98	26.63
5	11.837	8.505	.710	-.028	.594	.276	39.60	39.24
7	10.963	8.764	.811	.002	.551	.289	49.07	48.78
9	9.662	8.856	.457	.126	.485	.334	57.88	57.75
11	9.176	7.540	.400	.209	.461	.379	66.00	66.09
13	9.772	8.437	.470	.314	.491	.424	73.41	73.77
15	11.580	8.889	.680	.367	.581	.446	81.70	82.41
17	11.965	9.235	.728	.407	.602	.464	89.05	89.97
19	10.691	9.813	.577	.474	.537	.493	96.93	97.73
21	9.958	9.958	.491	.491	.500	.500	100.00	100.00

FC	FC1X	FC1Y	BETA1F	CD11	CL11	MC1LE	CP1LE
.370	-.308	.211	-34.689	-.019	.370	.146	39.468

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.677	8.852	.592	.362	.586	.444	95.57	93.37
45	12.340		.769		.619		112.63	
47		8.347		-.246		.268		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	HN12 TLRN P)TP	MN1Y,2 M12 P)BP	MN1Y,2 DF)1,2 P)NP	PT)2 V)2 P)SP	P12 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
.30	6.284	1.106	.957	.555	19.200	8.923	.964	30.108
	7.574	36.742	.300	.720	1154.049	19.929	19.874	19.902
	19.176	11.355	11.809	11.689	11.571	-1.842	19.901	563.838
5.30	6.363	1.106	.947	.571	19.244	8.942	.966	31.009
	8.565	36.751	.029	.676	1154.173	20.031	19.941	19.986
	19.222	11.498	11.708	11.753	11.576	-1.851	19.985	564.183
9.90	6.442	1.853	.892	.560	18.886	9.369	.948	32.109
	9.575	34.741	.029	1.034	1108.823	20.018	19.963	19.990
	18.883	11.523	11.488	11.714	11.497	.149	19.990	563.838
14.90	6.521	.895	.746	.495	17.993	10.693	.903	33.548
	11.014	33.302	.027	1.927	967.406	19.956	19.902	19.929
	17.993	11.462	11.152	11.502	11.238	1.598	19.928	563.838
19.90	6.600	.808	.668	.455	16.572	10.789	.832	34.251
	11.717	32.599	.025	3.349	854.107	19.935	19.902	19.918
	16.572	11.307	10.939	11.249	11.007	2.301	19.918	563.838
24.98	6.679	.600	.509	.318	13.786	10.809	.692	31.961
	9.407	34.889	.020	6.135	574.371	19.968	19.934	19.951
	13.786	11.031	11.030	10.842	10.710	.011	19.950	564.183
29.98	6.758	.476	.453	.146	12.511	10.796	.633	17.877
	-4.657	48.973	.016	7.310	542.380	20.006	19.951	19.979
	12.511	10.732	11.487	10.610	10.544	-14.073	19.978	564.183

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

A)2 0, A 11	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0, A T)1
108 902 838	35.24	6.838 -5.352 13.793	.603 49.868 10.537	.575 .018 11.849	.178 6.127 10.501	13.793 677.323 10.438	10.791 19.982 -14.778	.692 19.858 19.920	17.182 19.920 563.838
009 986 183	40.24	6.917 -3.911 15.352	.717 48.227 10.434	.680 .022 12.122	.229 4.569 10.625	15.352 794.866 10.707	10.897 20.006 -13.337	.771 19.963 19.984	18.623 19.985 563.493
109 900 838	45.24	6.996 -1.319 16.872	.820 45.635 10.465	.765 .025 12.233	.297 3.049 10.902	16.872 896.463 11.078	10.844 20.001 -10.745	.847 19.947 19.973	21.215 19.974 563.838
548 929 838	50.23	7.275 1.384 18.009	.894 42.952 10.664	.818 .028 12.221	.362 1.912 11.189	18.009 966.553 11.351	10.713 19.995 -8.062	.924 19.942 19.968	23.808 19.968 563.838
251 918 838	55.23	7.154 3.658 18.601	.951 40.588 10.904	.863 .029 12.136	.424 1.320 11.337	18.601 1027.908 11.455	10.273 19.995 -5.768	.934 19.951 19.972	25.192 19.973 563.838
961 951 183	60.23	7.233 5.395 18.712	1.053 38.921 11.036	.930 .029 11.969	.493 1.205 11.337	18.716 1108.823 11.416	9.284 19.957 -4.031	.940 19.935 19.945	27.929 19.945 563.838
877 979 183	65.02	7.312 7.027 18.525	1.053 37.289 11.054	.916 .029 11.603	.519 1.412 11.268	18.509 1108.823 11.338	9.182 19.944 -2.399	.929 19.896 19.920	29.561 19.920 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DSV PT1YP	MN)2 TURN PTTP	MN)X,2 M12 P1BP	MN)Y,2 DP)1,2 P1MP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 7.136 17.531	.885 37.125 10.999	.768 .027 11.413	.439 2.420 11.030	17.501 957.417 11.053	10.521 19.922 -2.223	.879 19.877 19.899	29.730 19.899 564.183
75.22	7.470 .959 15.875	.742 43.347 10.739	.680 .725 11.884	.298 4.246 10.755	15.675 819.434 10.846	10.878 19.974 -8.447	.787 19.922 19.948	23.503 19.948 564.183
80.21	7.549 1.849 17.939	.986 42.467 10.867	.925 .926 12.145	.374 1.981 11.233	17.939 977.344 11.244	10.538 19.978 -7.577	.901 19.945 19.961	24.383 19.962 564.183
85.21	7.628 4.441 18.827	1.387 39.875 12.981	.968 .929 12.786	.493 1.081 11.385	18.840 1137.448 11.507	8.972 19.982 -4.975	.946 19.940 19.960	26.975 19.961 564.183
90.21	7.707 5.889 18.876	1.373 38.427 11.102	.944 .929 11.948	.511 1.236 11.543	18.884 1125.281 11.546	9.139 19.932 -3.537	.948 19.882 19.906	28.423 19.907 563.493
95.20	7.786 6.737 18.759	.961 37.579 11.262	.839 .929 11.841	.470 1.162 11.636	18.759 1028.033 11.546	10.362 19.921 -2.679	.942 19.871 19.896	29.271 19.896 563.838
100.20	7.865 7.852 18.458	.986 36.664 11.352	.783 .928 11.707	.456 1.463 11.655	18.458 977.344 11.517	10.842 19.981 -1.764	.927 19.944 19.962	30.186 19.963 563.838

62531

295

15 sec

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 P112/PT11

.911 27.187 .882

CASCADE EXIT PARAMETERS
 BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.812	.418	17.556	10.262	563.838	1.166	1.011

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.739	.414	17.248	10.782	563.838	1.144	.647	29.275

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

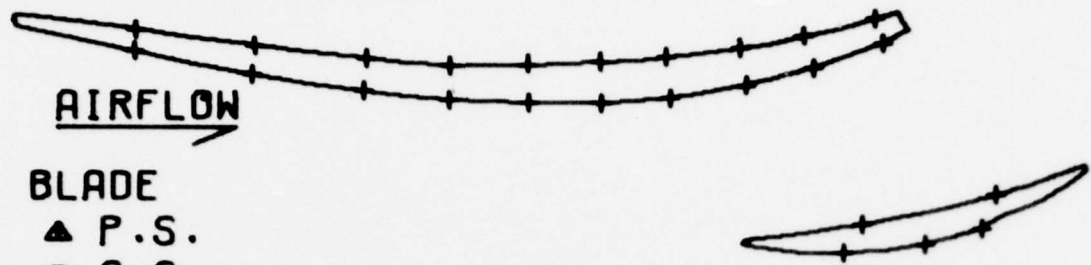
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.786	.882	.590	1.561	.343	1.462	1.224	.165
.039	.469	1.734	.604	1.236	.527	4.653	39.663
33.378	.439						

OVERALL PERFORMANCE

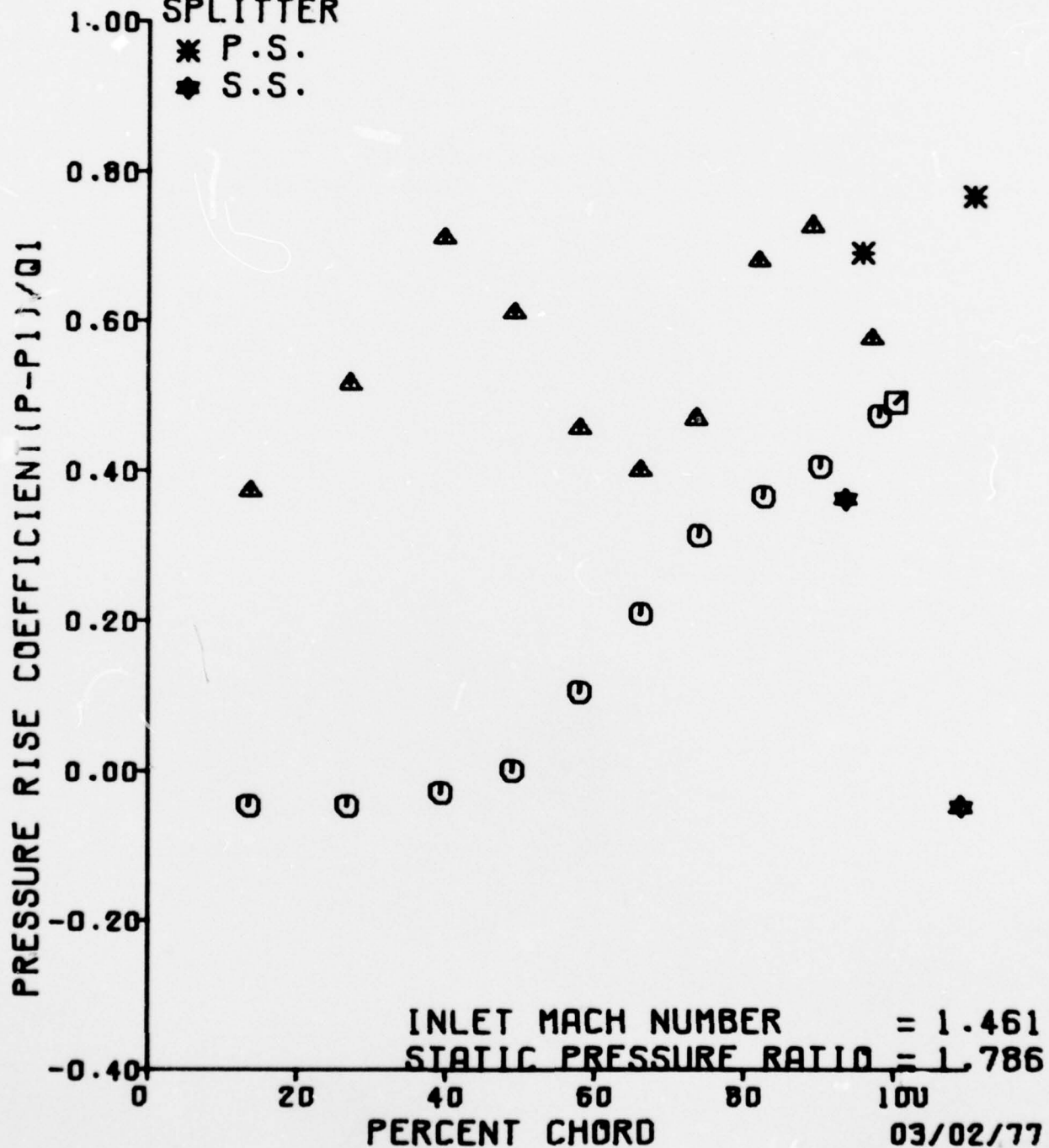
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.877	.866	.548	1.438	.345	1.505	1.247	.189
.043	.510	1.846	.603	1.179	.587	6.741	37.575
30.380	.482						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

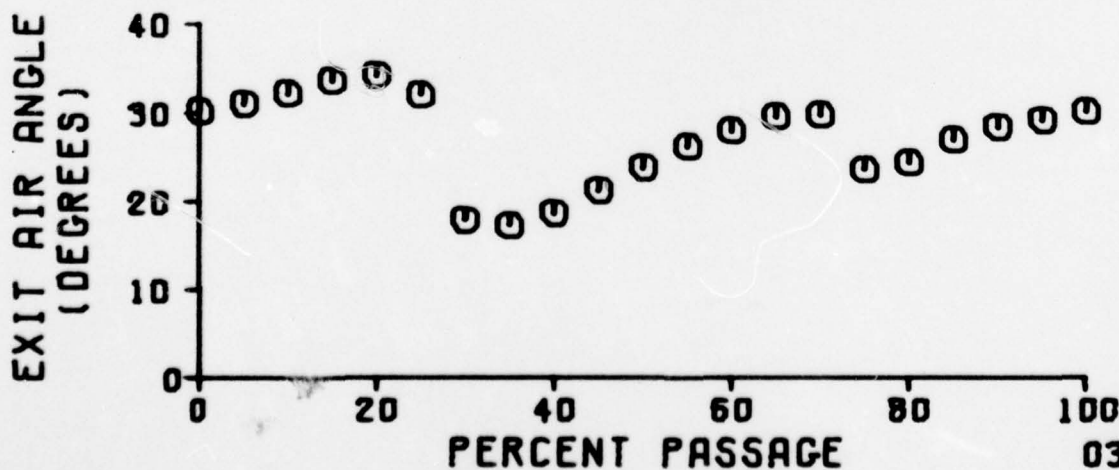
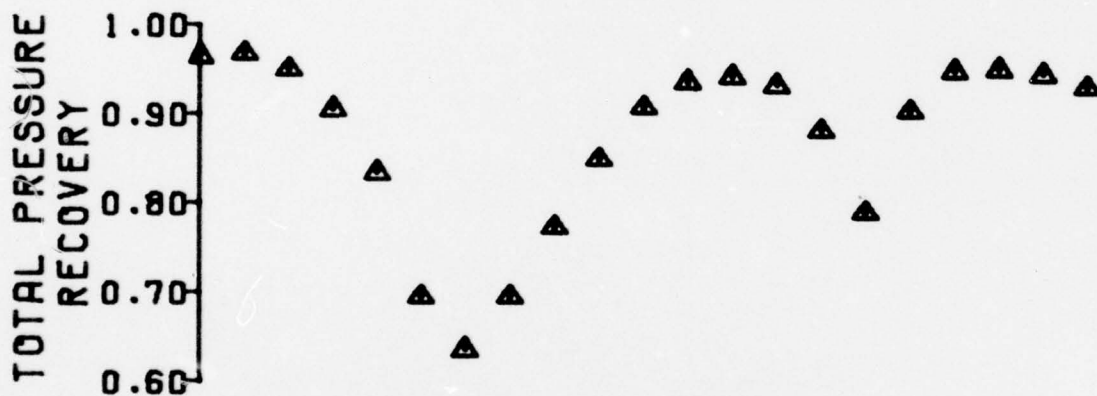


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 ◆ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.786





326685

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.786

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.828	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.867	1.501	58.050	24.305	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.154	43.087	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSTA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.993	10.997	20.000	19.985
11	18.292	8.640	9.249	1.764
13	11.375	8.573	10.296	5.356
15	11.719	9.672	11.860	5.563
17	11.683	14.524	10.988	5.888
19	11.518	11.229	9.678	6.825
21	19.861	10.311	9.213	7.707
23	9.840	14.526	9.949	8.590
25	9.906	10.323	11.694	8.981
27	10.294	9.720	12.069	9.360
29	10.215	10.312	10.798	9.936
31	9.984	14.538	10.076	19.983
33	10.288	10.364	10.066	2.127
35	10.005	10.998	10.064	2.732
37	9.918	10.140	10.060	1.616
39	10.146	14.520	10.110	1.624
41	10.526	10.893	10.101	1.785
43	10.955	14.529	11.803	8.860
45	5.039	19.966	12.416	2.168
47	19.942	10.977	19.998	5.409

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	48%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.824	1.581	.236	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.932	563.838	9.000	65.695

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.931	563.838	66.850	5.746	.241	8.582
I)SS	I)ML	MN)X,1	MN)Y,1	TI/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.469	1.428

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.849	33	10.288
25	9.996	35	10.005
27	10.294	37	9.918
29	10.215	39	10.146
31	9.984	41	10.526

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO [P]2/[P]1
10.067	.163	10.177	.215	1.038	1.752

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.076
		33	10.066
		35	10.064
		37	10.060
		39	10.110
		41	10.101

MEAN TRAILING EDGE PRESSURE [PSIA] 10.080 RMS DEVIATION .019

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.127 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.732 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.616 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.624 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.769 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.785 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.056 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.325 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.078

11
13
15
17
19
21
23
25
27
29
31

43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.249	5.356	.408	-.045	.464	.269	13.69	13.45
13	10.296	5.356	.530	-.045	.517	.269	26.98	26.63
15	11.860	5.863	.713	-.021	.595	.279	39.60	39.24
17	10.988	5.888	.611	.017	.551	.295	49.07	48.78
19	9.678	6.825	.458	.126	.486	.342	57.88	57.75
21	9.213	7.707	.404	.229	.462	.387	66.00	66.09
23	9.949	8.590	.490	.331	.499	.431	73.41	73.77
25	11.604	8.981	.693	.377	.587	.451	81.70	82.41
27	12.069	9.360	.737	.421	.606	.470	89.05	89.97
29	10.798	9.938	.589	.488	.542	.499	96.93	97.73
30	10.085	10.085	.506	.506	.506	.506	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.374	-.308	.212	-34.517	-.021	.373	.145	38.753

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	11.803	8.869	.706	.364	.592	.445	95.57	93.37
45	12.416		.777		.623		110.63	
47		5.409		-.039		.271		100.00

2

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1/1P	MN12 TURN P1/1P	MN1Y,2 M12 P1BP	MN1Y,2 DF11,2 P1MP	PT12 V12 P1SP	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
.30	6.284	1.184	.954	.556	19.232	8.959	.965	30.251
	7.717	36.599	.920	.699	1152.484	19.963	19.906	19.934
	19.209	11.407	11.826	11.724	11.587	-1.699	19.934	563.838
5.00	6.363	1.297	.939	.567	19.159	9.008	.961	31.116
	8.582	35.734	.929	.773	1146.211	19.977	19.918	19.947
	19.140	11.525	11.729	11.784	11.592	-.834	19.947	563.838
9.99	6.442	.933	.790	.497	18.759	10.696	.941	32.108
	9.664	34.652	.928	1.173	1002.211	19.989	19.937	19.963
	18.759	11.564	11.511	11.747	11.592	.248	19.962	563.838
14.99	6.521	.879	.734	.485	17.782	10.749	.892	33.450
	10.916	33.400	.927	2.149	952.575	19.939	19.896	19.917
	17.782	11.467	11.184	11.525	11.252	1.500	19.917	563.838
19.99	6.600	.784	.651	.438	16.311	10.866	.818	33.922
	11.388	32.928	.924	3.620	861.505	19.923	19.911	19.917
	16.311	11.292	10.992	11.257	11.035	1.972	19.916	563.838
24.98	6.679	.583	.497	.305	13.682	10.869	.686	31.547
	9.013	35.303	.920	6.250	656.616	19.973	19.927	19.953
	13.682	11.066	11.099	10.889	10.775	-.403	19.952	563.838
29.98	6.758	.477	.453	.148	12.686	10.859	.637	18.136
	-4.398	48.714	.918	7.245	542.575	19.984	19.950	19.967
	12.686	10.789	11.535	10.685	10.625	-13.824	19.967	564.183

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT11P	MN12 TURN P11P	MN1Y,2 M12 P11P	MN1Y,2 DP11,2 P11P	PT12 V12 P11P	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 TT11
35.24	6.838 -4.966 13.862	.598 49.282 10.649	.872 .018 11.919	.181 6.070 10.588	13.862 672.757 10.542	10.882 20.011 -14.382	.695 19.969 19.989	17.568 19.900 563.838
40.24	6.917 -3.710 15.356	.715 48.028 10.459	.677 .022 12.114	.231 4.576 10.661	15.356 792.625 10.739	10.922 19.941 -13.126	.770 19.902 19.921	18.824 19.921 563.838
45.24	6.996 -1.206 16.816	.811 45.522 10.512	.756 .025 12.235	.295 3.115 10.932	16.816 887.774 11.097	10.907 19.986 -10.632	.844 19.942 19.964	21.328 19.964 564.183
50.23	7.075 1.577 17.946	.891 42.739 10.688	.813 .028 12.193	.364 1.985 11.156	17.946 963.423 11.331	10.714 19.964 -7.849	.900 19.845 19.904	24.111 19.904 563.838
55.23	7.154 3.539 18.536	.926 40.777 10.929	.832 .029 12.138	.407 1.396 11.345	18.536 996.166 11.474	10.647 19.964 -5.877	.930 19.916 19.940	26.073 19.940 563.838
60.23	7.233 5.097 18.656	.964 39.219 11.078	.854 .029 12.007	.447 1.275 11.398	18.656 1030.639 11.477	10.270 19.972 -4.319	.936 19.941 19.955	27.631 19.956 563.838
65.22	7.312 6.973 18.530	1.053 37.343 11.159	.916 .020 11.719	.519 1.398 11.336	18.533 1108.823 11.385	9.194 20.003 -2.443	.930 19.977 19.990	29.507 19.990 563.403

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,4 T)1
70.32	7.391 7.173 17.341	.863 37.143 11.332	.750 .027 11.437	.428 2.590 11.041	17.341 937.294 11.101	10.664 20.002 -2.253	.870 19.895 19.948	29.707 19.948 563.838
75.22	7.470 .732 15.644	.735 43.584 19.760	.675 .025 11.021	.290 4.288 10.798	15.644 812.524 10.907	10.926 19.976 -8.694	.785 19.942 19.950	23.266 19.959 563.838
30.31	7.560 1.887 17.926	.894 42.420 10.725	.614 .026 12.173	.370 2.806 11.075	17.926 966.033 11.276	10.673 19.983 -7.529	.890 19.971 19.976	24.421 19.977 563.838
15.21	7.628 4.270 18.687	1.253 40.046 10.885	.940 .029 12.073	.475 1.261 11.388	18.671 1108.823 11.516	9.262 19.948 -5.146	.937 19.891 19.915	26.804 19.915 563.838
10.21	7.727 5.541 18.800	.963 38.775 11.156	.850 .029 11.095	.453 1.131 11.599	18.800 1029.479 11.594	10.354 19.960 -3.875	.943 19.907 19.933	28.075 19.933 563.838
15.20	7.786 6.803 18.716	.925 37.513 11.320	.806 .029 11.863	.453 1.215 11.672	18.716 994.633 11.596	10.771 20.005 -2.613	.939 19.952 19.978	29.337 19.979 563.838
10.20	7.855 7.621 18.309	.895 36.695 11.365	.774 .028 11.719	.450 1.623 11.658	18.309 967.406 11.502	10.881 19.963 -1.795	.919 19.917 19.940	30.155 19.940 563.838

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.881 27.135 .878

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT1 MN2/MN1

.784 .402 17.493 10.552 563.838 1.155 1.005

MIXED EXIT CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT1 MN2 BETA12

.726 .401 17.185 10.949 563.838 1.137 .829 28.906

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

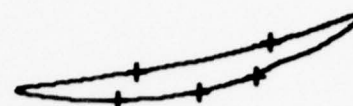
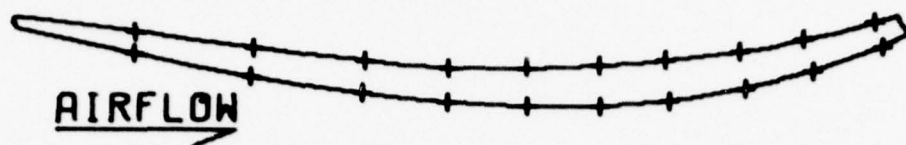
P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EQ	DV1Y	EN12	DPS/Q1	DEV	TURN
RETA1C	A12/A11						
1.836	.878	.671	1.518	.333	1.487	1.235	.172
.040	.491	1.788	.614	1.215	.560	4.601	39.715
32.476	.443						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EQ	DV1Y	EN12	DPS/Q1	DEV	TURN
RETA1C	A12/A11						
1.908	.862	.636	1.415	.334	1.519	1.254	.194
.045	.525	1.883	.612	1.163	.606	6.372	37.944
29.400	.465						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

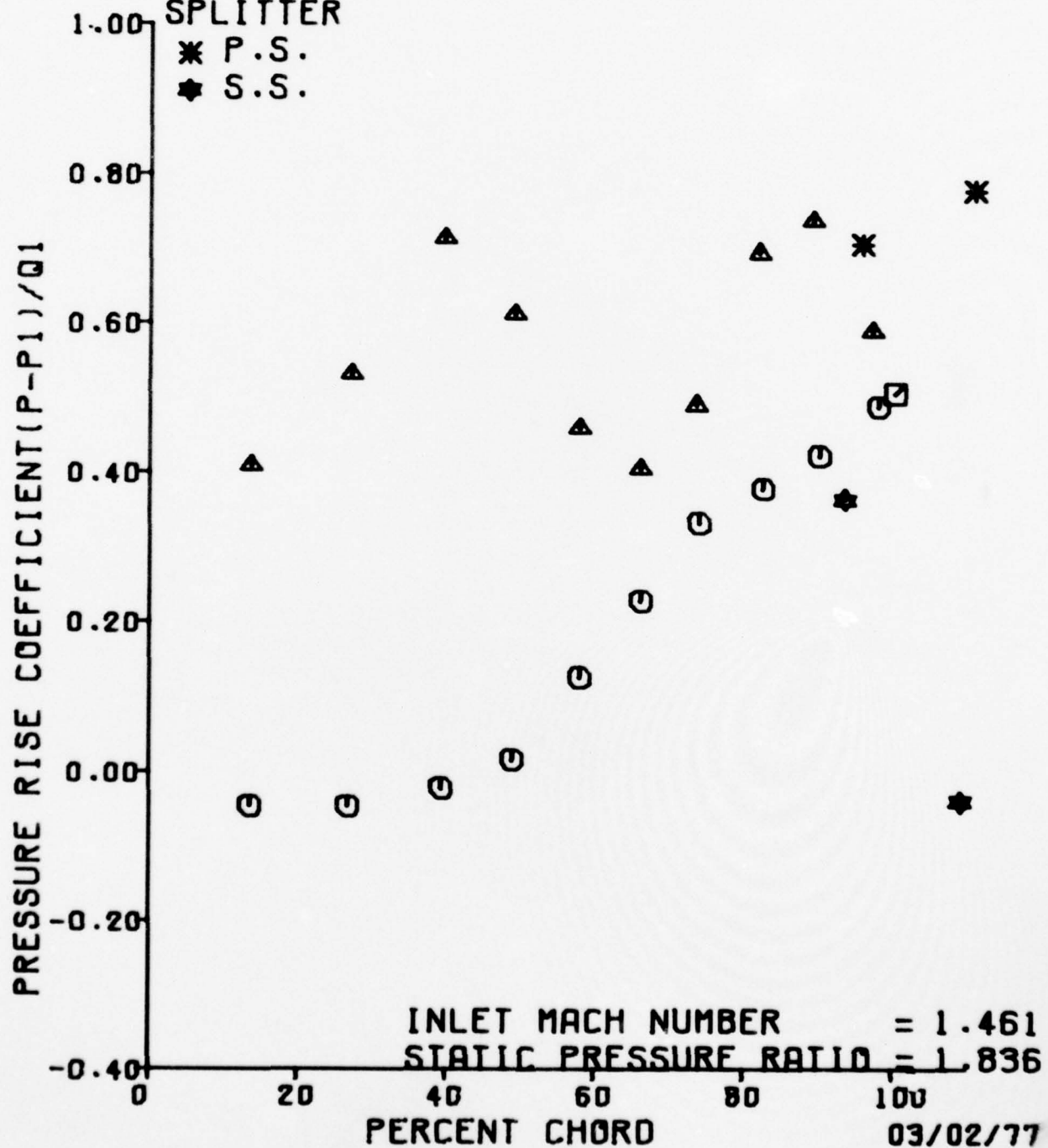
○ S.S.

□ T.E.

SPLITTER

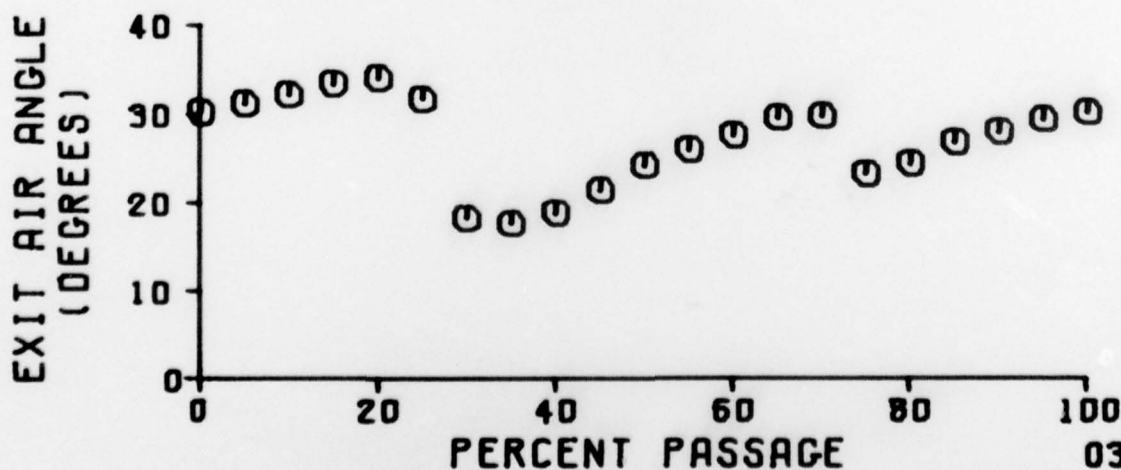
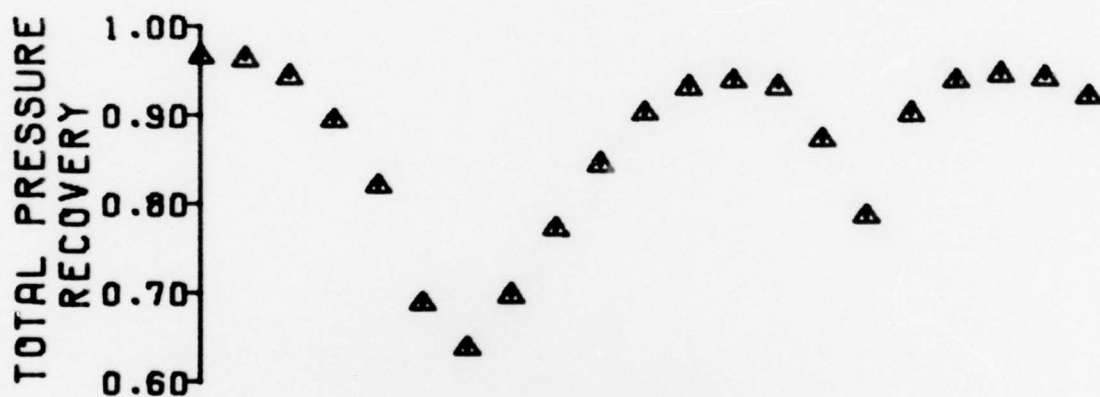
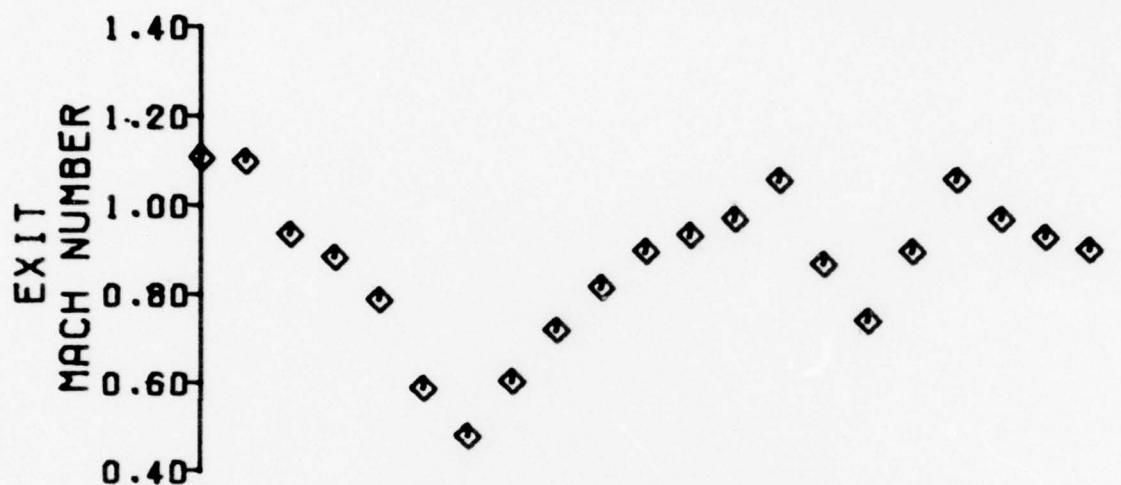
* P.S.

★ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.836



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.878	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG. R)
7.870	1.502	58.070	24.316	564.183

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.166	43.101	1.460	1.000	1.059

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSTA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.977	10.963	10.970	10.956
11	18.229	8.636	10.425	1.729
13	11.570	9.522	10.836	5.403
15	12.018	10.065	11.879	5.725
17	11.887	14.521	10.927	6.598
19	11.768	11.481	9.634	7.284
21	10.943	10.302	9.454	8.564
23	10.357	14.523	10.906	9.290
25	10.461	10.301	12.160	9.466
27	10.711	10.148	12.428	9.995
29	10.623	10.791	11.272	10.544
31	10.463	14.533	10.658	10.971
33	10.770	10.985	10.648	2.100
35	10.504	11.406	10.645	2.820
37	10.420	10.609	10.641	1.694
39	10.603	14.517	10.695	1.704
41	10.960	11.296	10.688	1.819
43	10.982	14.525	12.211	8.880
45	4.972	10.956	12.702	2.185
47	10.946	10.951	10.968	6.173

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.165	.045	48%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.955	564.183	9.007	65.684

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	19.955	564.183	66.850	5.756	.241	8.592
I)SS	I)ML	MN)X,1	MN)Y,1	TI/T)1	PI/P)1	NR/10**6
1.371	3.402	.574	1.343	1.426	3.467	1.428

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.357	33	10.779
25	10.461	35	10.504
27	10.711	37	10.429
29	10.623	39	10.603
31	10.483	41	10.560

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
10.523	.127	10.655	.192	1.002	1.828

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.658
		33	10.648
		35	10.645
		37	10.641
		39	10.695
		41	10.688

MEAN TRAILING EDGE PRESSURE (PSIA) 10.662 RMS DEVIATION .021

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.100 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.820 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.694 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.704 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.114 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.819 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.000 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.410 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.009

62581

310

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45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3.10 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.425	5.403	.543	-.041	.522	.271	13.69	13.45
13	10.836	5.403	.591	-.041	.543	.271	26.98	26.63
15	11.879	5.725	.713	-.004	.595	.287	39.60	39.24
17	10.927	6.508	.802	.098	.548	.331	49.07	48.78
19	9.634	7.284	.451	.178	.483	.365	57.88	57.75
21	9.454	8.564	.430	.327	.474	.429	66.00	66.09
23	10.906	9.280	.599	.411	.547	.466	73.41	73.77
25	12.160	9.466	.745	.432	.609	.474	81.70	82.41
27	12.428	9.995	.777	.493	.623	.501	89.05	89.97
29	11.272	10.544	.642	.557	.565	.528	96.93	97.73
0	10.668	10.668	.572	.572	.535	.535	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.382	-.317	.212	-33.812	-.026	.381	.137	35.922

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.211	8.889	.751	.365	.612	.445	95.57	93.37
45	12.702		.808		.637		110.53	
47		8.173		.049		.309		109.00

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN PT)P	MN)X,2 (M)2 PT)P	MN)Y,2 DF)1,2 PT)P	PT)2 V)2 PT)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
.20	6.284 7.291 19.680	.927 37.025 11.621	.804 .002 12.068	.461 .874 11.969	19.080 996.655 11.810	10.957 19.995 -2.105	.956 19.945 19.969	29.825 19.972 564.183
5.00	6.363 8.297 18.892	.906 36.919 11.745	.778 .029 11.973	.464 1.063 11.993	18.892 977.643 11.760	11.097 20.000 -1.109	.947 19.959 19.979	30.831 19.979 564.183
9.00	6.442 9.129 18.249	.863 35.207 11.711	.735 .028 11.767	.453 1.706 11.944	18.249 937.580 11.643	11.222 19.974 -.297	.914 19.927 19.950	31.643 19.951 564.183
14.00	6.521 9.769 17.367	.812 34.547 11.602	.686 .026 11.540	.434 2.588 11.793	17.367 888.545 11.506	11.258 19.945 .373	.870 19.890 19.917	32.303 19.918 564.528
19.00	6.600 10.182 15.804	.716 34.134 11.474	.603 .023 11.370	.387 4.061 11.611	15.894 794.327 11.381	11.290 19.918 .786	.796 19.872 19.897	32.716 19.898 564.183
24.00	6.679 7.906 13.786	.544 36.410 11.370	.469 .019 11.483	.276 6.167 11.328	13.788 615.675 11.212	11.272 19.972 -1.490	.691 19.935 19.953	30.443 19.954 564.183
29.00	6.758 -3.215 12.958	.456 47.531 11.176	.430 .016 11.814	.151 6.997 11.118	12.958 520.191 11.058	11.236 19.943 -12.611	.649 19.892 19.917	19.319 19.918 564.528

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)SP	MN)Y,2 OF)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O P)11	BETA)2 PT)O,A T)11
35.24	6.838 -4.442 13.921	.559 48.758 11.835	.531 .017 12.129	.174 6.834 11.015	13.921 631.099 11.027	11.262 19.964 -13.838	.698 19.922 19.942	18.092 19.943 564.523
40.24	6.917 -3.004 15.299	.671 47.320 18.940	.633 .021 12.370	.224 4.656 11.076	15.299 748.446 11.178	11.312 20.029 -12.410	.767 19.973 20.000	19.530 20.001 564.183
45.24	6.996 -1.938 16.580	.762 46.254 18.893	.709 .024 12.423	.281 3.375 11.202	16.580 840.231 11.393	11.282 19.950 -10.334	.831 19.889 19.919	21.596 19.920 564.528
50.23	7.075 1.420 17.790	.840 42.896 11.843	.768 .027 12.465	.341 2.165 11.433	17.790 915.391 11.650	11.209 19.965 -7.976	.892 19.915 19.939	23.954 19.940 564.528
55.23	7.154 3.577 18.396	.880 40.739 11.228	.790 .028 12.357	.387 1.558 11.595	18.396 953.212 11.736	11.116 19.972 -5.819	.922 19.920 19.946	26.111 19.946 564.528
60.23	7.233 4.862 18.368	.881 39.454 11.319	.783 .029 12.200	.406 1.587 11.607	18.368 954.666 11.701	11.080 19.934 -4.534	.920 19.885 19.900	27.396 19.913 563.838
65.02	7.312 6.523 18.064	.872 37.793 11.339	.763 .028 11.885	.424 1.871 11.557	18.084 946.246 11.607	11.014 19.925 -2.883	.906 19.880 19.902	29.057 19.903 564.183

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	PN)2 TURN P)TP	MN)Y,2 M)2 P)BP	PN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.391 6.657 16.951	.796 37.659 11.305	.695 .026 11.746	.388 3.004 11.399	15.951 873.349 11.453	11.161 19.997 -2.749	.849 19.945 19.970	29.191 19.971 564.183
75.02	7.470 .953 15.443	.688 43.363 11.078	.631 .024 12.100	.274 4.512 11.115	15.443 765.362 11.191	11.255 19.986 -8.453	.774 19.927 19.956	23.487 19.956 564.183
80.01	7.549 2.194 17.444	.830 42.122 11.008	.754 .025 12.254	.347 2.511 11.316	17.444 905.721 11.431	11.106 19.937 -7.212	.874 19.895 19.915	24.729 19.916 564.528
85.01	7.628 3.475 18.116	.853 40.841 11.151	.776 .028 12.260	.379 1.839 11.571	18.116 937.580 11.664	11.141 19.986 -5.921	.908 19.935 19.960	26.009 19.960 564.183
90.01	7.707 4.918 18.307	.877 39.398 11.327	.778 .028 12.195	.404 1.558 11.732	18.307 950.748 11.770	11.147 19.971 -4.478	.922 19.915 19.942	27.452 19.943 564.528
95.00	7.786 6.113 18.474	.877 38.203 11.464	.770 .028 12.103	.421 1.481 11.869	18.474 950.881 11.801	11.192 19.928 -3.283	.926 19.892 19.909	28.647 19.910 564.528
100.00	7.865 7.133 18.303	.863 37.183 11.577	.750 .028 12.006	.427 1.552 11.901	18.303 937.580 11.765	11.256 19.981 -2.263	.917 19.923 19.952	29.667 19.952 564.183

62531

312

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.800 26.688 .864

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)Y,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 M)2/M)1

.714 .362 17.234 11.305 564.183 1.128 .975

MIXED EXIT CONDITIONS

MN)Y,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/TT)2 MN)2 BETA)2

.678 .362 16.972 11.485 564.183 1.118 .768 28.073

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.964	.864	.816	1.388	.303	1.553	1.265	.192
.048	.553	1.949	.641	1.146	.546	4.334	39.982
28.459	.461						

OVERALL PERFORMANCE

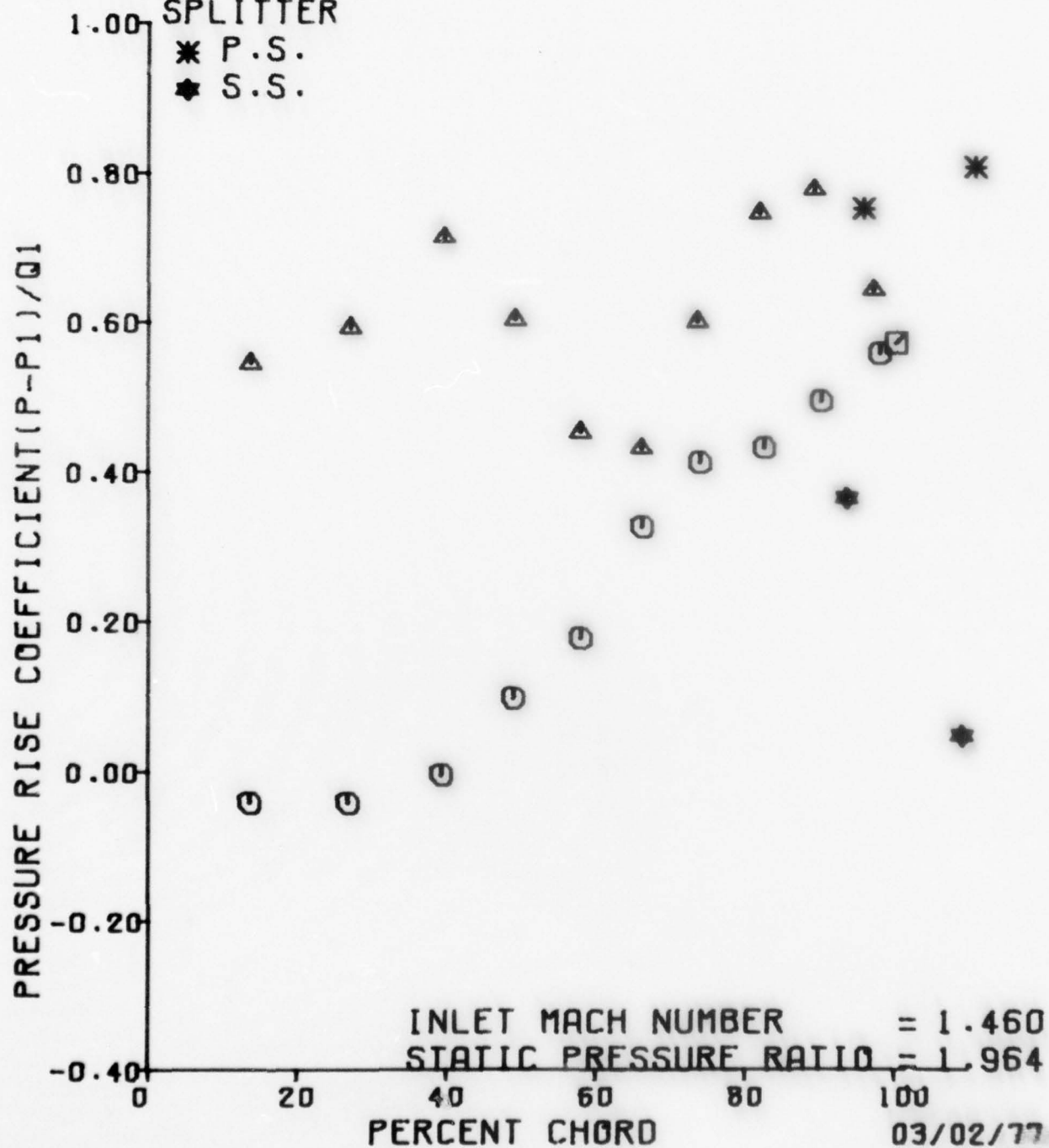
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.995	.851	.594	1.334	.304	1.564	1.276	.210
.049	.574	2.021	.640	1.106	.667	5.539	38.777
25.142	.479						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

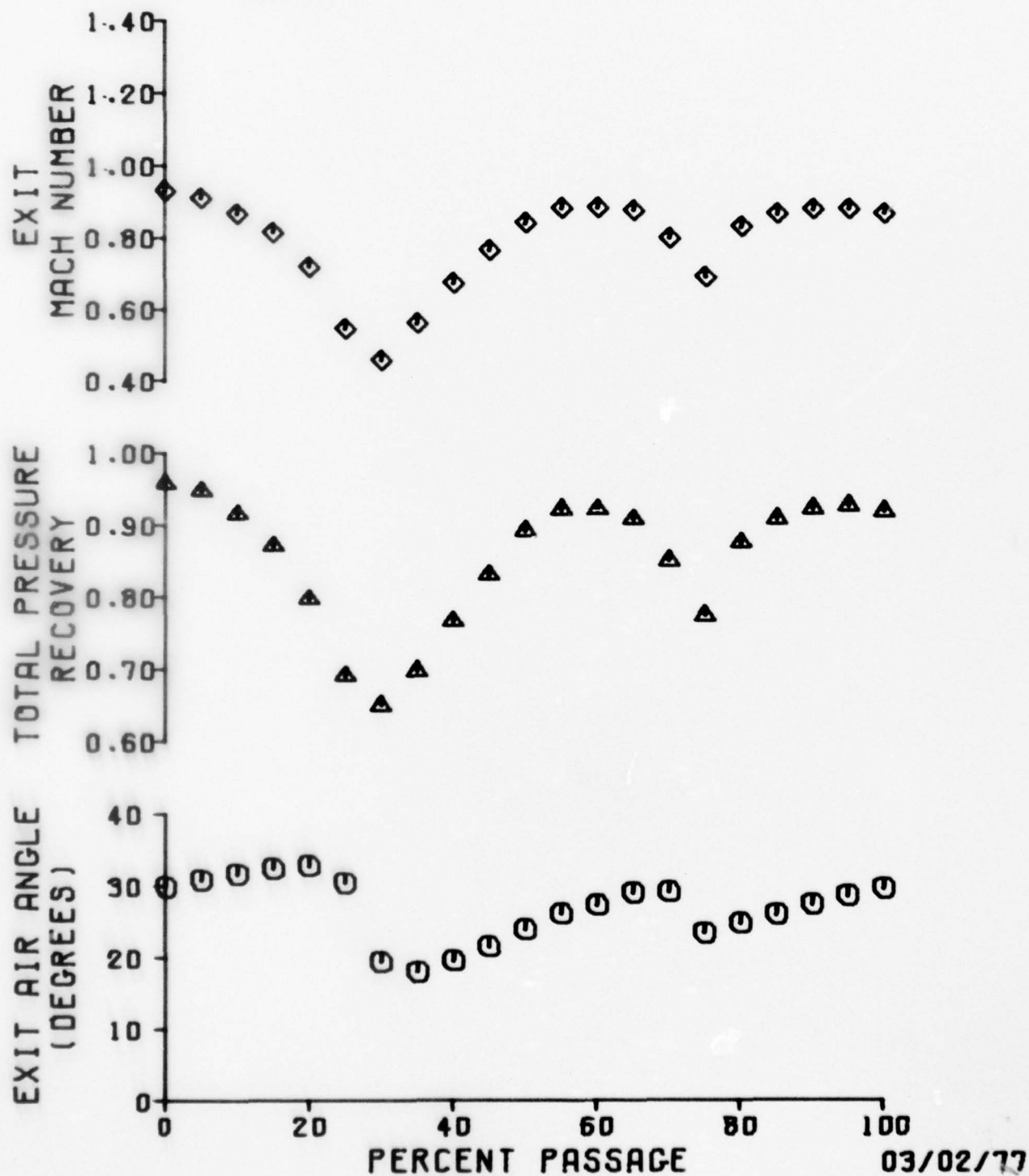


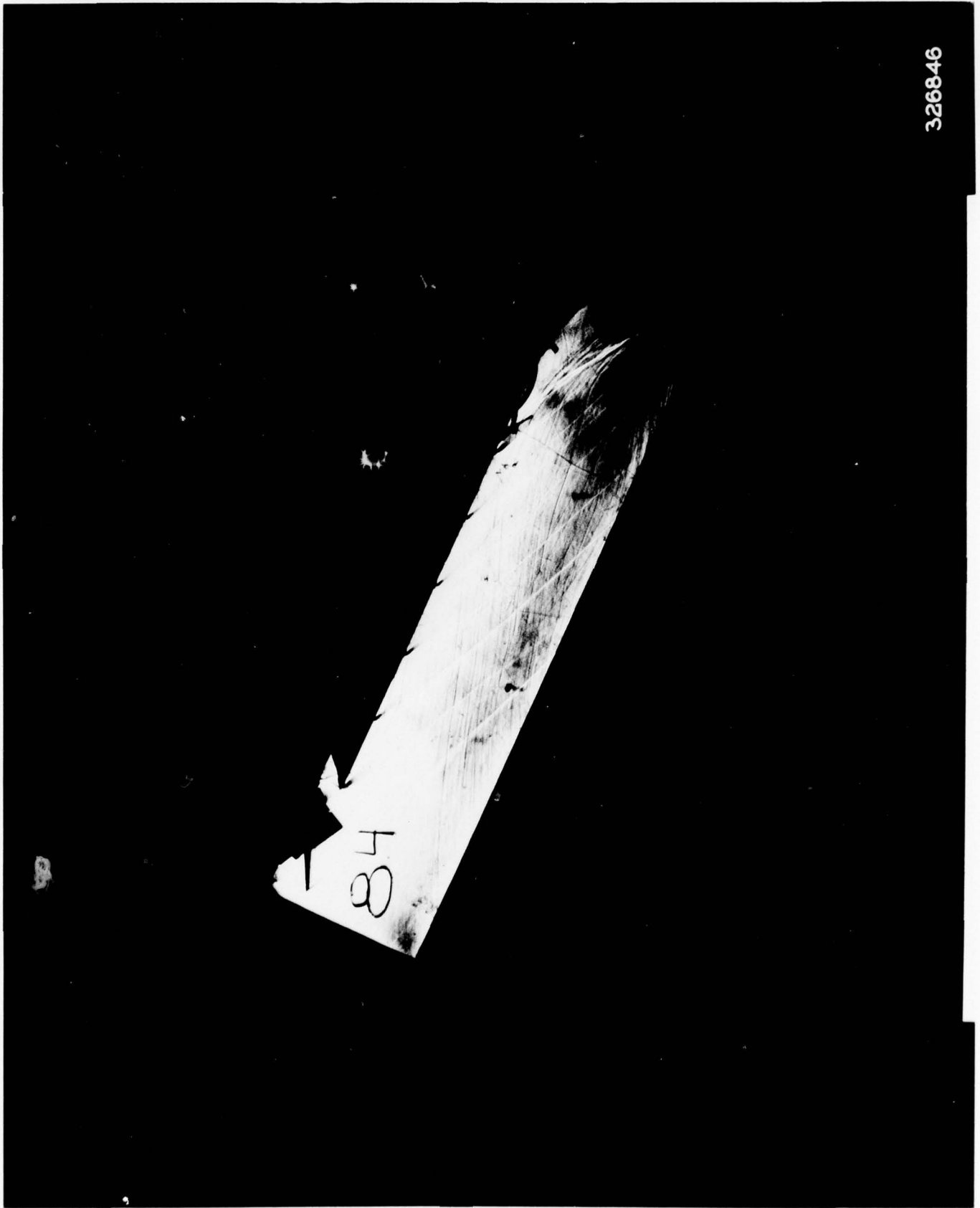
BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.964





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CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.964

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.891	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.870	1.502	58.060	24.311	564.183

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.161	43.095	1.460	1.000	1.059

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.940	10.950	10.947	10.934
11	10.258	6.620	10.708	1.795
13	11.671	10.094	10.976	5.507
15	12.180	10.347	11.807	5.816
17	12.031	14.517	10.828	7.106
19	11.900	11.538	9.533	8.019
21	10.900	10.317	9.775	9.073
23	10.677	14.517	11.448	9.648
25	10.737	10.316	12.398	9.800
27	10.960	10.476	12.625	10.368
29	10.860	11.065	11.536	10.905
31	10.741	14.528	10.976	10.953
33	11.074	11.378	10.970	2.150
35	10.815	11.672	10.969	2.799
37	10.754	10.895	10.967	1.615
39	10.884	14.513	11.056	1.638
41	11.232	11.552	11.049	1.796
43	10.964	14.510	12.353	8.870
45	4.978	10.975	12.930	2.226
47	10.966	10.969	10.979	6.993

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	48%



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.984	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.527	19.935	564.183	8.998	65.689

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.450	19.935	564.183	66.850	5.749	.241	8.583
I)SS	I)ML	PN)X,1	PN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.458	1.427

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

(LANE)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.677	33	11.074
25	10.737	35	10.815
27	10.960	37	10.754
29	10.858	39	10.884
31	10.741	41	11.232

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1)
10.797	.103	10.952	.177	.979	1.878

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.976
		33	10.970
		35	10.969
		37	10.967
		39	11.056
		41	11.049

MEAN TRAILING EDGE PRESSURE (PSIA) 10.998 RMS DEVIATION .039

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.150 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.799 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.615 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.638 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.459 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.796 PSIA
SIDEWALL BLEED ORIFICE ΔP	=	.054 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.320 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.077

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

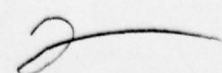
INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.728	5.597	.578	-.028	.537	.276	13.69	13.45
13	10.976	5.527	.609	-.028	.551	.276	26.98	26.63
15	11.827	5.816	.706	.006	.592	.292	39.60	39.24
17	10.828	7.106	.592	.158	.543	.356	49.07	48.78
19	9.533	8.019	.441	.264	.478	.402	57.88	57.75
21	9.775	9.073	.469	.387	.490	.455	66.00	66.09
23	11.448	9.648	.564	.454	.574	.484	73.41	73.77
25	12.398	9.800	.775	.472	.622	.492	81.70	82.41
27	12.625	10.368	.801	.538	.633	.520	89.25	89.97
29	11.536	10.905	.674	.601	.579	.547	96.93	97.73
3	11.012	11.012	.613	.613	.552	.552	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC1LE	CP1LE
.366	-.305	.222	-33.595	-.026	.365	.126	34.564

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.353	8.870	.769	.364	.620	.445	95.57	93.37
45	12.930		.837		.649		110.63	
47		6.993		.145		.351		100.00



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 RETA1P	PT12/PT11 PT10 PT11	RETA12 PT10,4 T111
.00	6.284	.869	.759	.422	18.642	11.398	.935	29.093
	6.559	37.757	.002	1.293	942.741	19.932	19.893	19.911
	18.642	11.587	12.242	12.091	11.910	-2.847	19.911	564.183
5.00	6.363	.869	.751	.436	18.666	11.415	.936	30.127
	7.593	36.723	.028	1.269	942.582	19.922	19.895	19.908
	18.666	11.802	12.155	12.156	11.894	-1.813	19.908	563.838
9.99	6.442	.848	.727	.437	18.358	11.467	.921	30.980
	8.446	35.872	.028	1.576	923.447	19.981	19.923	19.952
	18.358	11.863	12.040	12.178	11.863	-.950	19.952	564.183
14.99	6.521	.803	.679	.428	17.598	11.511	.883	32.211
	9.677	34.639	.026	2.337	879.858	20.017	19.970	19.994
	17.598	11.835	11.788	12.058	11.751	.281	19.993	564.183
19.99	6.600	.696	.586	.375	16.030	11.601	.804	32.629
	10.025	34.221	.024	3.904	773.383	19.939	19.924	19.932
	16.030	11.756	11.668	11.941	11.647	.689	19.931	564.528
24.98	6.679	.514	.444	.259	13.801	11.525	.692	30.282
	7.748	36.568	.019	6.133	583.324	19.928	19.893	19.912
	13.801	11.591	11.703	11.596	11.453	-1.648	19.910	564.528
29.98	6.758	.447	.420	.151	13.202	11.512	.662	19.777
	-2.757	47.273	.016	6.733	509.945	19.985	19.933	19.959
	13.202	11.457	12.057	11.401	11.366	-12.153	19.958	564.528

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1YP	MN12 TURN EXITP	MN1X,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 T111
293 911 183	35.24	6.838 -3.782 14.184	.543 48.098 11.327	.514 .017 12.331	.174 5.831 11.332	14.184 614.064 11.341	11.543 19.979 -13.178	.708 19.923 19.950	18.752 19.951 564.528
127 908 838	40.24	6.917 -2.532 15.297	.647 46.848 11.202	.608 .020 12.508	.221 4.638 11.344	15.297 723.614 11.424	11.545 19.961 -11.938	.767 19.910 19.935	20.002 19.936 564.183
980 952 183	45.24	6.096 -5.647 16.493	.735 44.963 11.154	.682 .024 12.567	.274 3.442 11.423	16.493 812.773 11.605	11.519 19.935 -10.053	.827 19.889 19.911	21.887 19.912 564.528
211 994 183	50.23	7.075 1.320 17.662	.806 42.996 11.267	.737 .026 12.634	.326 2.273 11.637	17.662 883.067 11.826	11.515 19.964 -8.076	.886 19.921 19.942	23.854 19.943 564.183
629 932 528	55.23	7.154 3.552 18.371	.855 40.764 11.431	.766 .028 12.532	.376 1.564 11.779	18.371 930.271 11.937	11.389 19.991 -5.854	.922 19.954 19.972	26.086 19.972 564.528
282 910 528	60.23	7.233 4.937 18.403	.863 39.379 11.508	.766 .029 12.357	.398 1.532 11.772	18.403 937.580 11.881	11.317 19.936 -4.469	.923 19.912 19.924	27.471 19.924 564.183
777 959 528	65.22	7.312 6.398 18.158	.852 37.918 11.560	.746 .028 12.115	.412 1.777 11.780	18.158 926.787 11.838	11.300 19.978 -2.998	.911 19.944 19.961	28.932 19.961 564.528

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1X,2 M12 P1BP	MN1Y,2 OP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
70.02	7.391 6.878 17.218	.792 37.438 11.528	.690 .027 11.938	.389 2.717 11.628	17.218 869.277 11.681	11.384 19.992 -2.528	.864 19.949 19.970	29.412 19.973 564.528
75.02	7.472 1.399 15.422	.662 42.917 11.328	.605 .024 12.245	.269 4.513 11.360	15.422 739.261 11.452	11.491 19.931 -8.007	.774 19.897 19.913	23.933 19.914 564.183
83.21	7.549 3.186 17.438	.806 41.210 11.296	.726 .025 12.350	.349 2.497 11.550	17.438 882.484 11.634	11.375 19.967 -6.308	.875 19.929 19.937	25.640 19.938 564.183
88.21	7.628 4.084 17.758	.820 40.232 11.388	.733 .027 12.314	.368 2.177 11.694	17.758 896.737 11.763	11.414 19.987 -5.322	.891 19.934 19.960	26.618 19.963 564.528
92.21	7.707 4.569 17.879	.828 39.747 11.482	.730 .027 12.329	.374 2.056 11.865	17.879 896.737 11.856	11.491 19.962 -4.837	.897 19.942 19.952	27.103 19.952 564.183
95.00	7.756 5.513 18.134	.837 38.803 11.563	.739 .027 12.270	.394 1.891 11.958	18.134 912.900 11.879	11.456 19.905 -3.893	.910 19.848 19.876	28.047 19.876 564.528
100.00	7.865 6.638 18.328	.844 37.678 11.721	.737 .028 12.234	.411 1.696 12.084	18.328 919.102 11.955	11.502 19.974 -2.768	.910 19.916 19.945	29.172 19.945 564.528

SUPERSONIC COMPRESSOR CASCADE
ARL STREAKLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.773 26.890 .862

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 P)2/M)1

.690 .350 17.187 11.572 564.183 1.120 .963

MIXED EXIT CONDITIONS

MN)X,2 MN)Y,2 PT)2 P)2 TT)2 TT)2/T)2 MN)2 BETA)2

.657 .350 16.951 11.734 564.183 1.111 .744 26.039

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

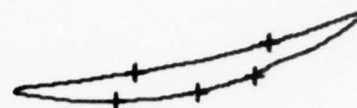
P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DE	DEEG	DVY	FN2	DPS/Q1	DEV	TURN
BETAC	A2/A1						
2.013	.862	.598	1.356	.294	1.580	1.274	.194
.245	.573	2.011	.648	1.124	.678	4.356	39.963
27.031	.467						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DE	DEEG	DVY	FN2	DPS/Q1	DEV	TURN
BETAC	A2/A1						
2.041	.850	.578	1.297	.295	1.580	1.284	.214
.049	.593	2.081	.648	1.286	.697	5.505	38.811
23.505	.485						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

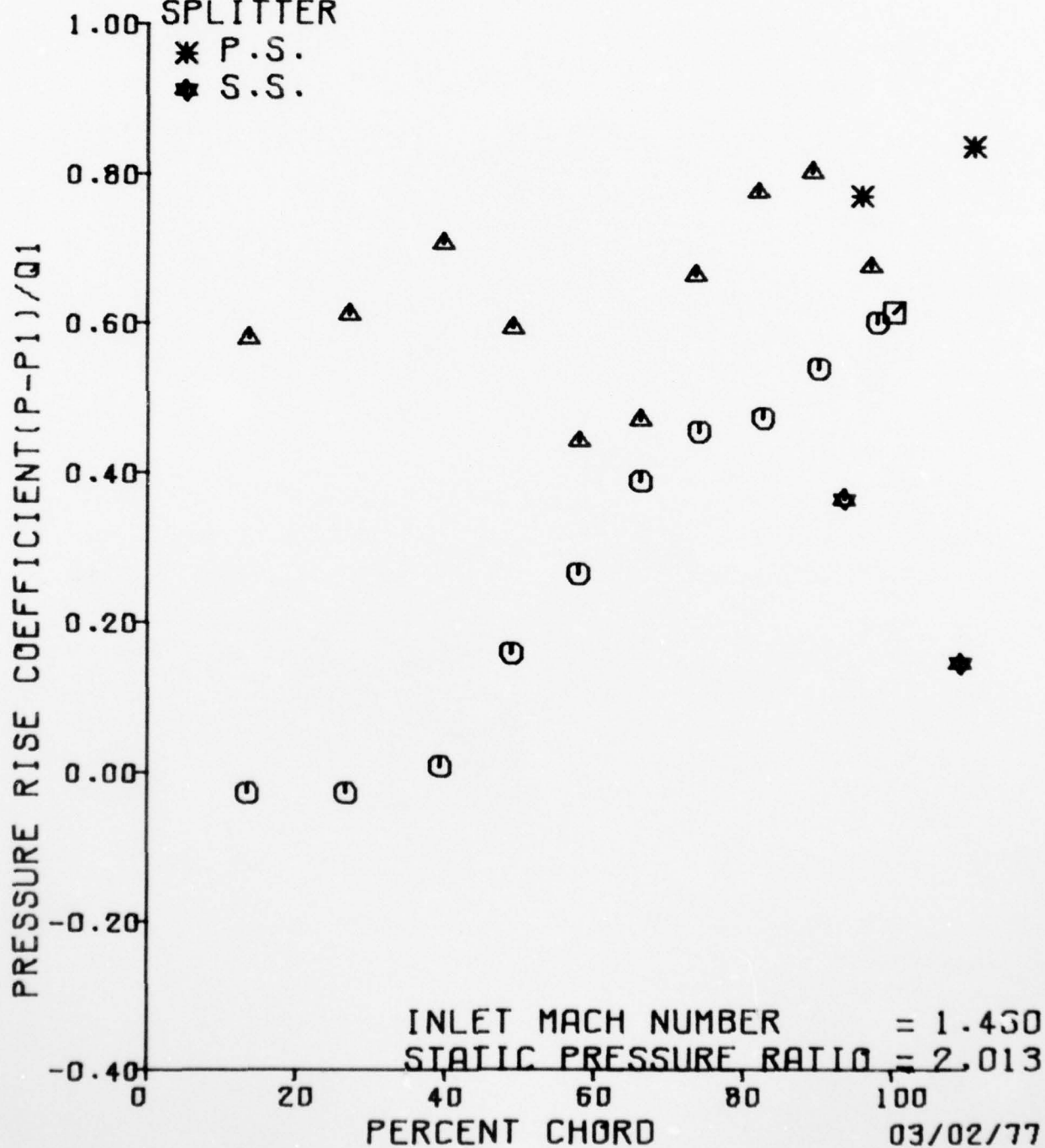
○ S.S.

□ T.E.

SPLITTER

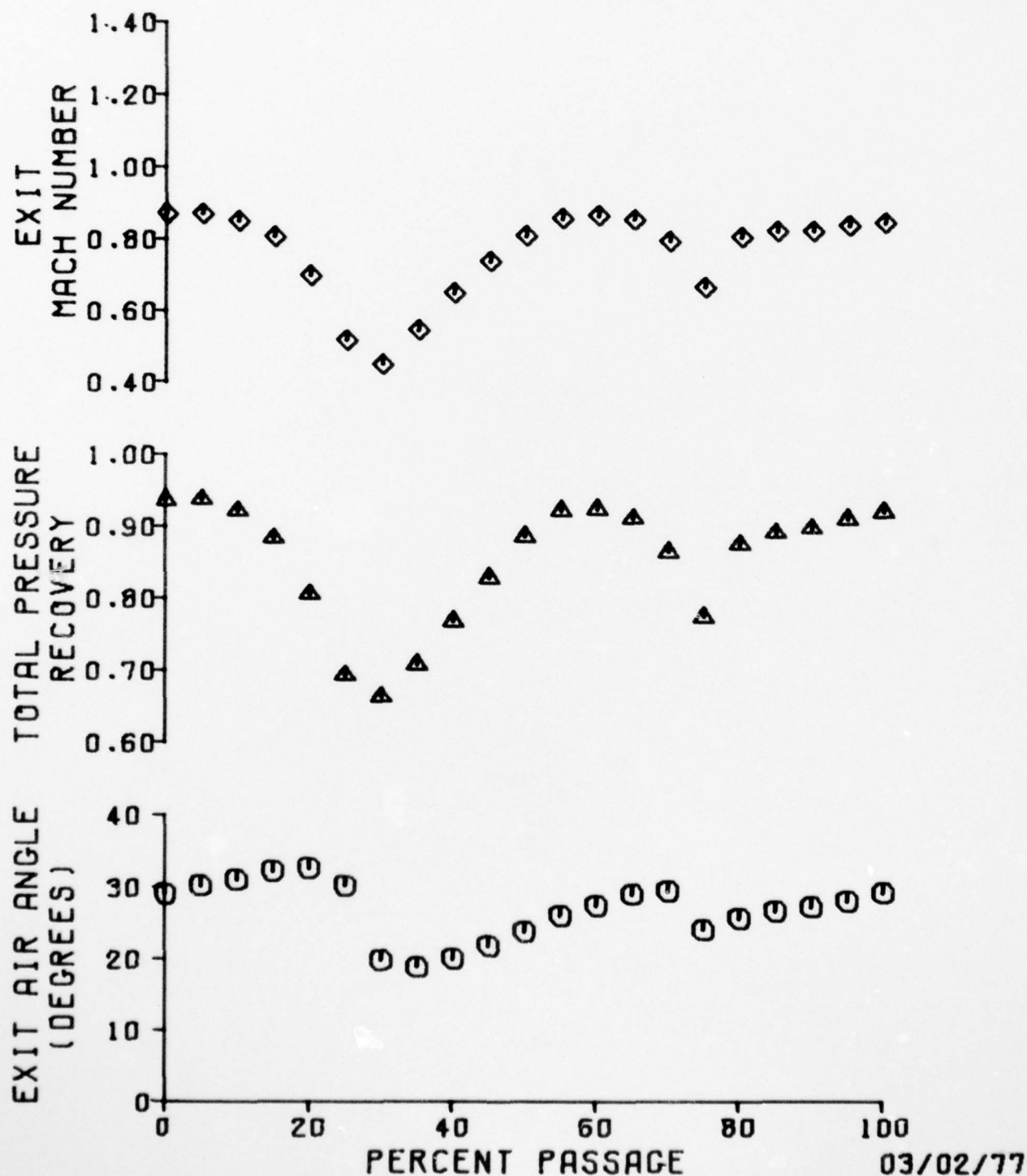
* P.S.

★ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 2.013



03/02/77



326848

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 2.013

APPENDIX H

CASCADE DATA

SPLITTER VANE POSITION = 45%

$$P)_2/P)_1 = 1.706$$

$$P)_2/P)_1 = 1.786$$

$$P)_2/P)_1 = 1.822$$

$$P)_2/P)_1 = 1.918$$

$$P)_2/P)_1 = 1.987$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.753	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.864	1.503	58.050	24.324	565.907

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.174	43.110	1.460	1.000	1.059

62581

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.965	10.971	10.968	10.968
11	10.836	6.645	7.858	1.662
13	11.272	8.186	9.810	5.355
15	11.757	8.715	11.804	5.239
17	11.533	14.545	11.237	5.419
19	11.558	10.401	9.781	5.990
21	10.874	9.128	8.903	6.955
23	9.774	14.547	8.913	7.859
25	9.857	9.130	10.901	8.799
27	10.138	11.815	11.687	9.192
29	10.937	10.213	10.593	9.667
31	9.813	14.550	9.911	10.967
33	10.100	9.561	9.909	1.997
35	9.774	10.859	9.898	1.835
37	9.829	9.967	9.892	1.540
39	9.950	14.545	9.828	1.411
41	10.371	10.748	9.818	1.712
43	10.932	14.552	12.123	8.917
45	5.018	10.934	12.539	5.252
47	10.912	10.941	10.952	5.249

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	45%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN10	PT10	TT10	M10	BETA10
1.508	19.917	565.907	8.976	65.676

CASCADE INLET CONDITIONS

PN11	PT11	TT11	BETA11	P11	M11	Q11
1.460	19.916	565.907	66.850	5.747	.241	8.575
I1SS	I1ML	PN1Y,1	PN1Y,1	TT/T11	PT/P11	NR/10**6
1.371	3.402	.574	1.342	1.426	3.465	1.420

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.774	33	10.100
25	9.857	35	9.774
27	10.138	37	9.829
29	10.037	39	9.950
31	9.813	41	10.371

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.924	.140	10.005	.214	1.049	1.727

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.911
		33	9.900
		35	9.898
		37	9.892
		39	9.828
		41	9.818

MEAN TRAILING EDGE PRESSURE [PSIA] 9.876 RMS DEVIATION .038

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.997 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	1.835 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.542 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.411 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.769 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.712 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.302 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

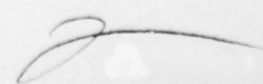
INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.858	5.355	.246	-.046	.395	.269	13.69	13.45
13	9.810	5.355	.474	-.046	.493	.269	26.98	26.63
15	11.804	5.239	.706	-.059	.593	.263	39.60	39.24
17	11.237	5.419	.540	-.038	.564	.272	49.87	48.78
19	9.781	5.990	.470	.028	.491	.301	57.88	57.75
21	8.903	5.955	.368	.141	.447	.349	66.00	66.09
23	8.913	7.889	.369	.246	.448	.395	73.41	73.77
25	10.901	8.799	.601	.356	.547	.442	81.70	82.41
27	11.687	9.192	.693	.402	.587	.462	89.05	89.97
29	10.593	9.667	.565	.457	.532	.485	96.93	97.73
0	9.860	9.860	.480	.480	.495	.495	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CL)1	CL)1	MC)LE	CP)LE
.356	-.293	.204	-34.848	-.018	.356	.147	41.152

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.123	8.917	.744	.370	.609	.448	95.57	93.37
45	12.539		.792		.630		110.63	
47		5.249		-.058		.264		109.00



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN PT)P	MN)Y,2 M)2 PT)P	MN)Y,2 DP)1,2 PT)P	PT)2 V)2 PT)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,4 1)1
.20	6.284 6.294 18.753	1.097 38.022 11.000	.961 .000 11.749	.529 1.135 11.304	18.781 1148.332 11.498	8.838 19.951 -3.122	.943 19.906 19.928	28.828 19.928 565.907
5.20	6.363 7.586 19.021	1.105 36.730 11.273	.955 .029 11.722	.554 .872 11.502	19.045 1154.936 11.583	8.867 19.970 -1.840	.955 19.913 19.941	30.120 19.942 565.907
9.09	6.442 8.674 18.975	1.104 35.642 11.381	.944 .029 11.561	.572 .918 11.519	18.998 1153.960 11.539	8.858 19.835 -1.742	.954 19.826 19.830	31.208 19.830 565.907
14.09	6.521 10.403 18.817	1.098 33.913 11.510	.921 .028 11.272	.597 1.081 11.461	18.836 1148.920 11.443	8.848 19.953 .987	.946 19.911 19.931	32.937 19.932 565.907
19.09	6.600 11.975 17.518	.878 32.341 11.435	.724 .026 10.982	.498 2.398 11.217	17.518 953.321 11.159	10.602 20.004 2.549	.860 19.912 19.957	34.509 19.958 565.907
24.08	6.679 11.465 14.866	.692 32.851 11.193	.573 .022 10.952	.387 5.051 10.843	14.866 770.497 10.745	10.797 19.961 2.049	.746 19.901 19.931	33.999 19.931 566.252
29.08	6.758 -1.183 12.554	.478 45.479 10.773	.445 .017 11.343	.174 7.363 10.603	12.554 545.039 10.470	10.736 19.965 -10.579	.630 19.906 19.935	21.371 19.935 565.907

62531

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

A)2 C,4 01	PERCT	Y DEV PT)YP	AN)2 TURN P)TP	AN)Y,2 M)2 P)RP	AN)Y,2 DP)1,2 P)MP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 TT)1
828 928 907	35.24	6.838 -7.003 13.476	.576 51.319 10.521	.555 .017 11.843	.154 6.440 10.432	13.476 650.418 10.348	10.762 20.026 -16.419	.677 19.927 19.976	15.531 19.977 565.907
120 942 907	40.24	6.917 -5.143 14.999	.703 49.459 10.351	.671 .021 12.105	.210 4.917 10.466	14.999 782.495 10.498	10.780 19.960 -14.559	.753 19.902 19.930	17.391 19.931 565.907
208 830 907	45.24	6.996 -2.416 16.737	.820 46.732 10.327	.770 .025 12.257	.282 3.180 10.727	16.737 898.106 10.952	10.757 19.951 -11.832	.840 19.905 19.928	20.118 19.928 565.907
937 932 907	52.23	7.075 .778 18.059	.906 43.538 10.543	.832 .028 12.240	.359 1.827 11.072	18.089 979.136 11.332	10.526 19.945 -8.638	.908 19.892 19.918	23.312 19.918 565.907
509 958 907	55.23	7.154 3.499 16.642	1.029 40.517 10.828	.924 .029 12.168	.452 1.273 11.333	16.643 1089.906 11.507	9.519 19.975 -5.917	.936 19.920 19.947	26.033 19.947 565.907
909 931 252	60.23	7.233 4.804 18.787	1.053 39.422 11.059	.935 .029 12.109	.485 1.126 11.443	18.791 1110.855 11.546	9.322 19.985 -4.522	.943 19.935 19.960	27.428 19.963 565.562
371 935 907	65.22	7.312 5.918 19.013	1.098 38.398 11.211	.965 .029 12.060	.523 .884 11.486	19.032 1149.241 11.523	8.936 20.041 -3.498	.956 20.006 20.023	28.452 20.023 565.907

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MX)2 TURN P)TP	MX)X,2 M)2 P)RP	MX)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 T)1
70.02	7.391 6.937 18.989	1.183 37.379 11.243	.961 .929 11.845	.543 .905 11.480	19.011 1153.733 11.453	8.867 19.930 -2.479	.955 19.908 19.919	29.471 19.919 565.562
75.02	7.470 8.542 18.860	1.126 35.774 11.191	.964 .929 11.405	.581 1.018 11.310	18.898 1172.863 11.272	8.569 19.983 -1.874	.949 19.939 19.961	31.076 19.961 565.907
80.01	7.549 5.559 16.051	.778 38.757 10.926	.686 .926 11.496	.366 3.866 10.845	16.051 856.361 10.810	10.765 19.942 -3.857	.806 19.885 19.913	28.093 19.913 565.562
85.01	7.628 1.310 16.902	.828 43.006 10.662	.757 .925 12.016	.335 3.014 10.918	16.902 905.248 11.017	10.782 19.978 -8.106	.849 19.933 19.955	23.844 19.955 565.907
90.01	7.707 4.520 19.029	1.120 39.796 10.827	.998 .928 12.029	.509 .854 11.301	19.063 1167.834 11.449	8.707 19.983 -4.806	.957 19.915 19.949	27.054 19.949 565.907
95.00	7.786 5.161 19.135	1.115 38.155 11.104	.978 .930 11.906	.535 .751 11.498	19.166 1163.380 11.591	8.812 19.960 -3.255	.962 19.930 19.945	28.695 19.945 565.907
100.00	7.865 7.315 18.872	1.053 37.001 11.283	.913 .929 11.775	.524 1.041 11.550	18.876 1110.855 11.591	9.364 19.979 -2.101	.948 19.927 19.953	29.849 19.953 565.562

AD-A043 860

GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER F33615-76-C-2052

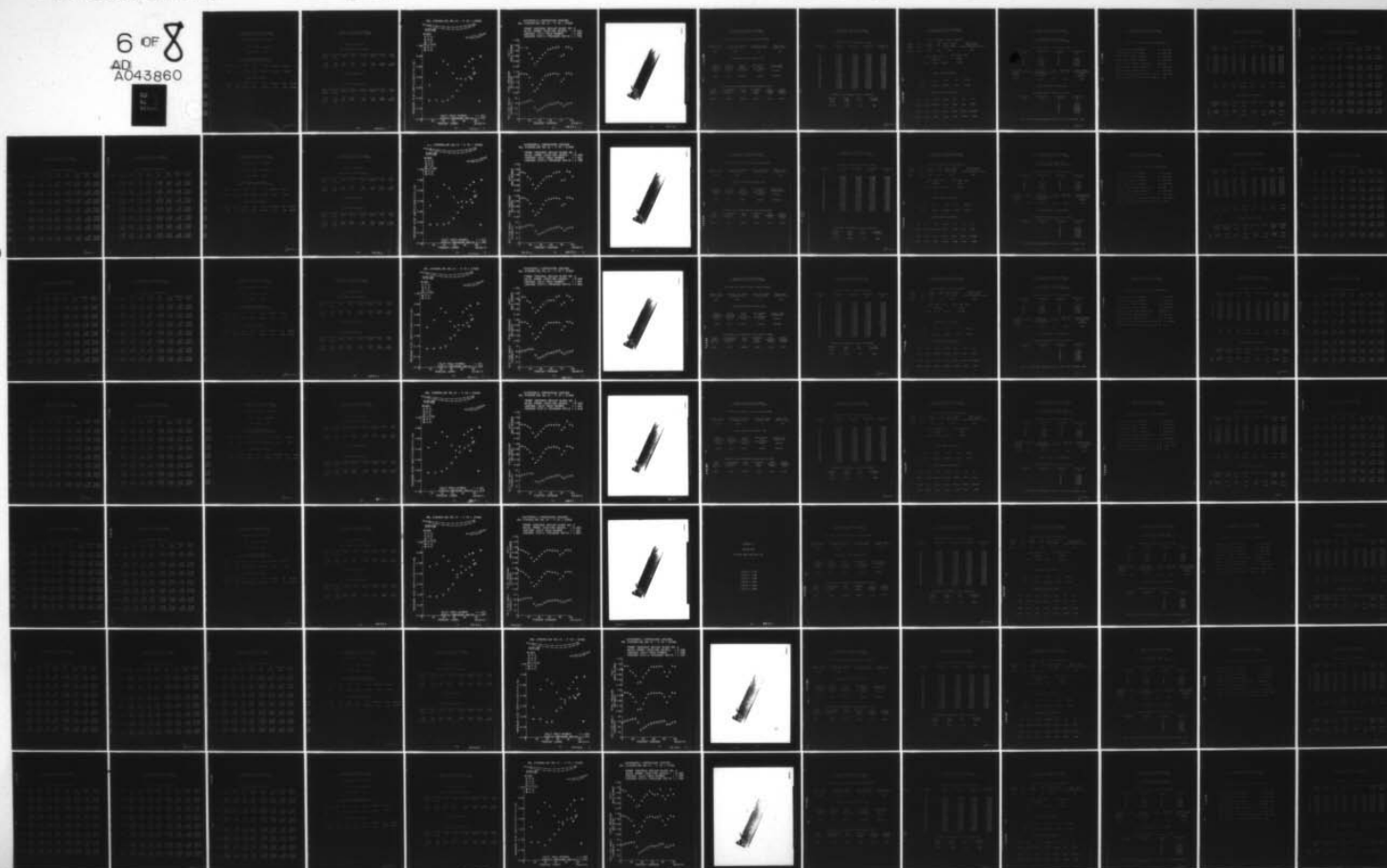
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6 OF 8
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A043860



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.963 27.302 .892

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	P)2/M)1
.855	.441	17.773	9.803	565.907	1.185	1.023

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	MN)2	BETA)2
.761	.438	17.435	10.554	565.907	1.154	.878	29.948

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

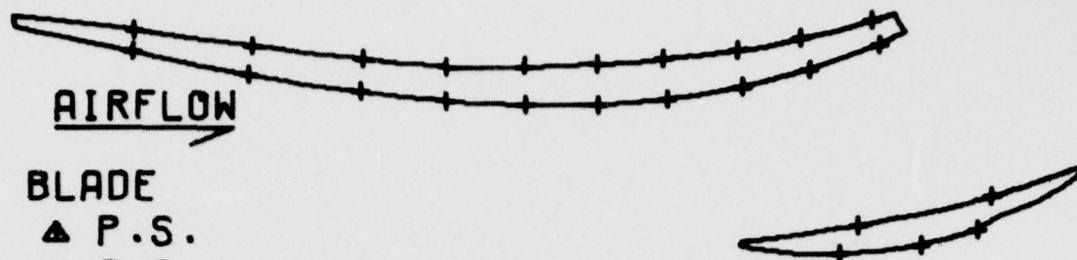
P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	P12/R11	T12/T11	OMEGA
TPLP	DF	DF1EQ	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.726	.892	.723	1.635	.361	1.418	1.203	.151
.035	.431	1.651	.588	1.267	.473	4.768	39.548
34.849	.432						

OVERALL PERFORMANCE

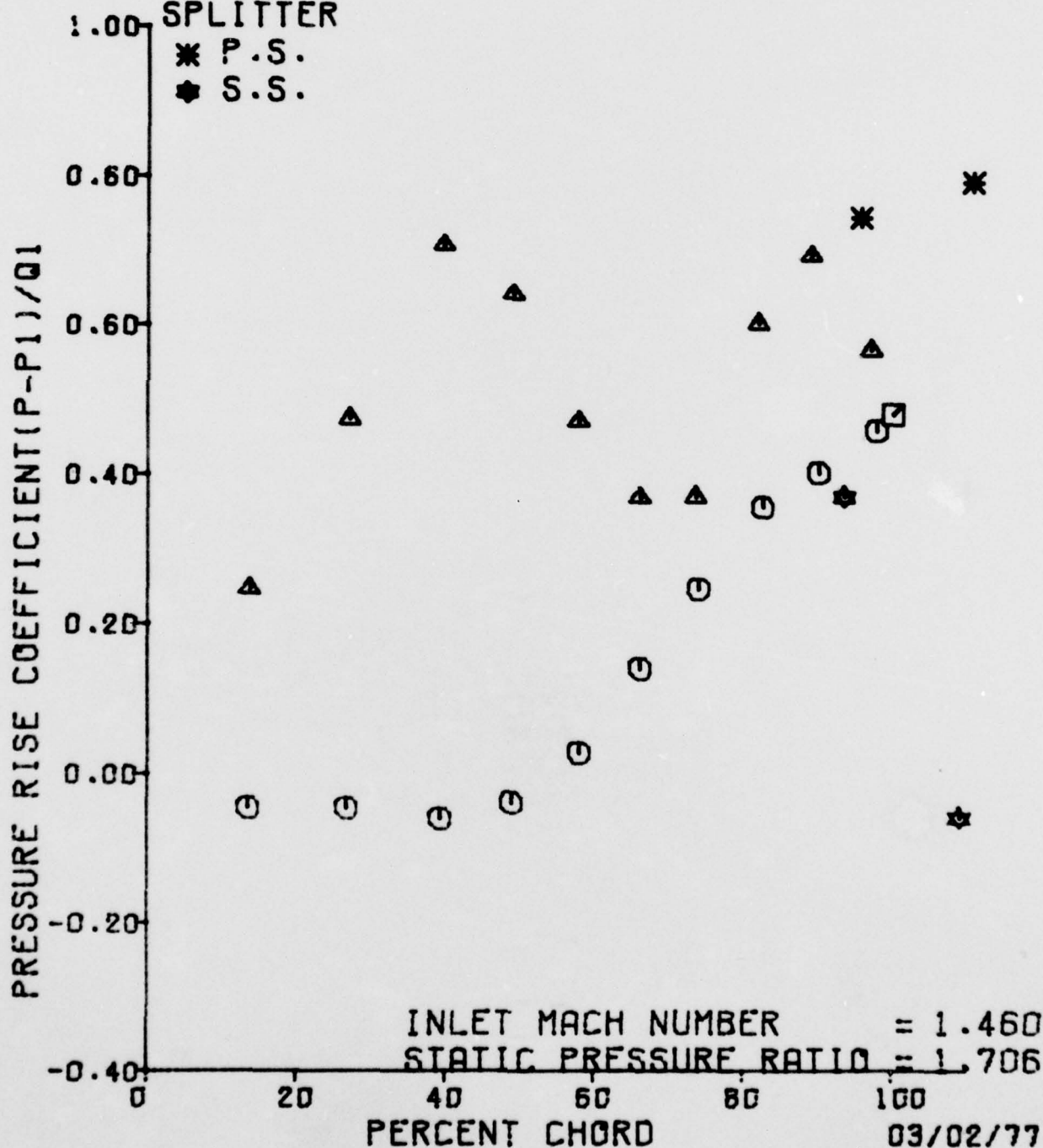
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	P12/R11	T12/T11	OMEGA
TPLP	DF	DF1EQ	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.836	.875	.669	1.474	.363	1.486	1.236	.175
.040	.486	1.786	.586	1.204	.561	7.414	36.902
32.141	.457						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

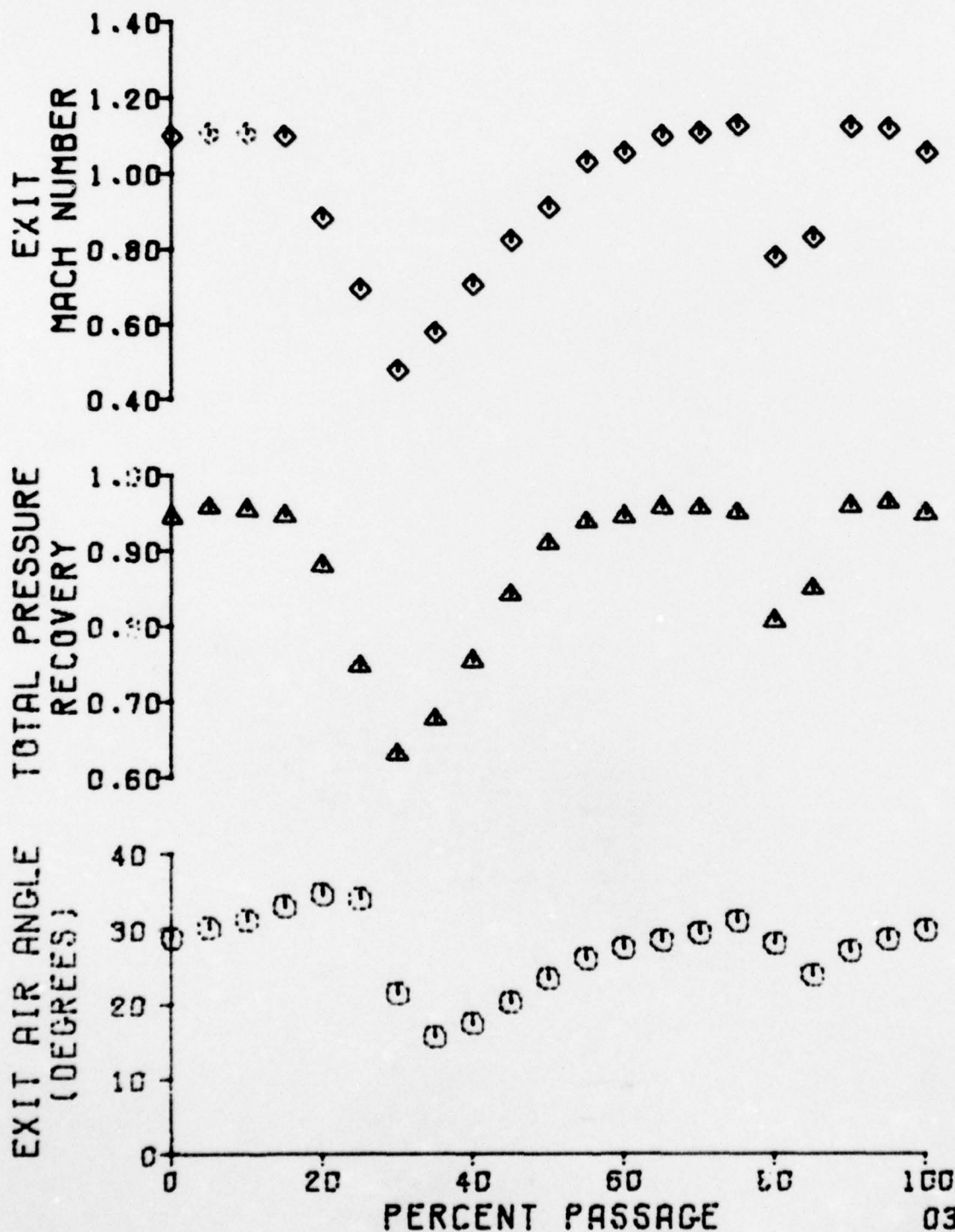


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.706



03/02/77



326851

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.706

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.799	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.870	1.501	57.950	24.284	565.562

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.135	43.066	1.461	1.000	1.057

62531

337

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.011	20.002	19.991	19.983
11	18.619	6.647	8.456	1.657
13	11.381	2.283	9.877	5.356
15	11.792	9.155	11.873	5.387
17	11.579	14.542	11.235	5.609
19	11.553	10.693	9.796	6.346
21	10.904	9.214	8.927	7.291
23	9.044	14.543	9.091	8.170
25	10.006	9.195	11.171	9.019
27	10.283	11.973	11.797	9.401
29	10.185	10.381	10.745	9.871
31	9.992	14.556	10.112	10.990
33	10.282	9.883	10.104	1.983
35	9.967	11.001	10.103	1.851
37	10.002	10.135	10.098	1.538
39	10.131	14.542	10.038	1.417
41	10.535	10.898	10.028	1.708
43	10.956	14.551	12.257	6.933
45	5.042	19.980	12.635	5.330
47	10.979	19.978	19.993	5.331

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	45%

2

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.324	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.965	565.562	9.001	65.716

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.964	565.562	66.850	5.750	.241	8.595
I)SS	I)ML	MN)Y,1	PN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.575	1.344	1.427	3.472	1.424

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.944	33	10.282
25	10.006	35	9.967
27	10.283	37	10.002
29	10.185	39	10.131
31	9.992	41	10.535

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.082	.130	10.184	.208	1.038	1.753

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.112
		33	10.104
		35	10.103
		37	10.098
		39	10.038
		41	10.028

MEAN TRAILING EDGE PRESSURE (PSIA) 10.081 RMS DEVIATION .034

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.983 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	1.851 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.538 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.417 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.459 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.708 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.051 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.304 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

62531

339

11
13
15
17
19
21
23
25
27
29

43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE


INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.456	5.356	.315	-.046	.424	.268	13.69	13.45
13	9.877	5.356	.480	-.046	.495	.268	26.98	26.63
15	11.873	5.357	.712	-.042	.595	.270	39.80	39.24
17	11.235	5.609	.638	-.016	.563	.281	49.07	48.78
19	9.706	5.346	.471	.069	.491	.318	57.88	57.75
21	8.927	7.291	.370	.179	.447	.365	66.00	66.09
23	9.091	8.170	.389	.282	.455	.409	73.41	73.77
25	11.171	9.019	.631	.380	.560	.452	81.70	82.41
27	11.797	9.401	.704	.425	.591	.471	89.05	89.97
29	10.745	9.871	.581	.479	.538	.494	96.93	97.73
0	10.268	10.058	.502	.502	.504	.504	100.00	100.00

FC	FC1Y	FC1Y	BETA1F	CD11	CL11	MD1E	CP1E
.357	-.294	.202	-34.496	-.020	.357	.141	39.615

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.257	8.933	.757	.370	.614	.447	95.57	93.37
45	12.535	-	.801	-	.633	-	110.53	-
47	-	5.331	-	-.049	-	.267	-	100.00



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1/P	MN12 TURN P1/P	MN1Y,2 M12 P1/P	MN1Y,2 DP11,2 P1/P	PT12 V12 P1/P	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10,4 PT11
.20	6.284 6.818 18.936	1.084 37.496 11.216	.945 .000 11.363	.531 1.016 11.489	18.949 1136.732 11.648	9.056 19.990 -2.698	.940 19.935 19.962	29.352 19.962 565.217
5.20	6.353 8.033 19.050	1.083 36.283 11.437	.932 .029 11.794	.551 .892 11.629	19.072 1135.897 11.679	9.126 19.997 -1.483	.955 19.890 19.943	30.567 19.944 565.907
9.99	6.442 9.276 18.974	1.053 35.040 11.547	.895 .029 11.604	.555 .987 11.636	18.977 1110.517 11.651	9.414 20.006 -1.240	.951 19.950 19.977	31.810 19.978 565.562
14.99	6.521 10.915 18.267	.906 33.401 11.567	.756 .028 11.274	.499 1.698 11.492	18.267 978.838 11.466	10.730 20.003 1.469	.915 19.959 19.981	33.449 19.981 565.562
19.99	6.600 11.895 16.964	.825 32.421 11.470	.681 .025 11.059	.467 3.000 11.243	16.964 902.566 11.100	10.849 19.985 2.449	.850 19.938 19.961	34.429 19.961 565.562
24.98	6.679 10.539 14.159	.521 33.777 11.222	.521 .021 11.117	.339 5.805 10.912	14.159 697.922 10.809	10.913 19.974 1.093	.709 19.937 19.955	33.073 19.955 565.562
29.98	6.758 -1.550 12.540	.456 44.876 10.941	.432 .016 11.457	.174 7.324 10.776	12.640 531.701 10.651	10.893 20.001 -10.006	.633 19.951 19.976	21.974 19.976 565.562

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 00,A 1)1	PERCT	Y DEV PT)YP	PN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A T)1
.352 .962 .217	35.04	6.838 -6.445 13.455	.556 50.761 10.699	.534 .017 11.002	.154 6.509 10.625	13.455 628.757 10.506	10.909 20.009 -15.891	.674 19.952 19.980	16.089 19.980 565.562
.567 .944 .907	40.04	6.917 -4.977 14.876	.576 49.293 10.550	.545 .020 12.181	.204 5.088 10.636	14.876 754.369 10.692	10.953 19.998 -14.423	.745 19.955 19.976	17.557 19.977 565.907
.810 .978 .562	45.04	6.996 -2.272 16.527	.790 46.588 10.508	.741 .024 12.317	.274 3.438 10.836	16.527 868.577 11.069	10.947 20.009 -11.718	.828 19.954 19.981	20.262 19.981 565.907
.449 .981 .562	50.03	7.075 .585 17.943	.882 43.731 10.666	.811 .028 12.344	.346 2.021 11.160	17.943 955.026 11.444	10.821 19.970 -8.861	.899 19.933 19.951	23.119 19.952 565.907
.429 .961 .562	55.03	7.154 3.152 18.604	.929 41.164 10.943	.837 .029 12.251	.403 1.361 11.375	18.604 1000.097 11.576	10.655 19.974 -6.314	.932 19.919 19.946	25.686 19.947 565.562
.073 .955 .562	60.23	7.233 4.330 18.702	.929 39.986 11.123	.828 .029 12.192	.420 1.262 11.494	18.702 999.786 11.619	10.715 19.990 -5.136	.937 19.946 19.967	26.864 19.969 565.562
.074 .976 .562	65.02	7.312 5.899 18.906	1.053 38.417 11.265	.926 .029 12.099	.501 1.055 11.534	18.909 1110.517 11.596	9.380 20.019 -3.567	.947 19.940 19.979	28.433 19.979 565.562

2

62581

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 RETA)P	PT)2/PT)1 PT)0 PT)1	RETA)2 PT)0,A TT)1
70.22	7.391 6.967 18.949	1.076 37.349 11.295	.937 .029 11.891	.530 1.006 11.542	18.958 1132.607 11.575	9.141 19.990 -2.499	.950 19.940 19.964	29.501 19.965 565.562
75.32	7.470 8.456 18.748	1.097 35.850 11.285	.940 .029 11.525	.565 1.198 11.379	18.766 1147.711 11.356	8.826 19.929 -1.000	.940 19.879 19.903	31.000 19.904 565.562
80.21	7.549 5.580 16.152	.770 38.736 11.060	.680 .026 11.631	.363 3.812 10.964	16.152 849.087 10.945	10.908 19.967 -3.886	.809 19.916 19.941	28.114 19.941 565.562
85.21	7.628 1.098 16.702	.800 43.218 10.761	.733 .025 12.093	.321 3.263 11.020	16.702 878.522 11.099	10.951 19.916 -8.368	.837 19.901 19.908	23.632 19.908 565.562
90.21	7.707 4.794 19.097	1.116 30.522 10.947	.091 .028 12.095	.512 .836 11.395	19.128 1163.654 11.519	8.787 19.957 -4.672	.958 19.926 19.946	27.328 19.947 565.562
95.20	7.786 6.319 10.055	1.095 37.998 11.211	.959 .030 11.976	.528 .892 11.565	19.072 1146.362 11.658	8.988 19.979 -3.147	.955 19.939 19.958	28.853 19.959 565.907
100.20	7.865 7.183 18.733	.925 37.133 11.370	.803 .029 11.846	.459 1.231 11.607	18.733 996.430 11.662	10.776 19.980 -2.283	.938 19.936 19.957	29.717 19.958 565.907

341

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MA12 BETA12 PT12/PT11

.915 27.353 .885

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MA1X,2 MA1Y,2 PT12 P12 TT12 TT12/TT1 P12/M11

.813 .421 17.561 10.267 565.562 1.168 1.028

MIXED EXIT CONDITIONS

MA1X,2 MA1Y,2 PT12 P12 TT12 TT12/TT1 MA12 BETA12

.732 .418 17.320 10.874 565.562 1.142 .843 29.725

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	P12/R11	T12/T11	OMEGA
TPLP	DE	DE/EO	DV/Y	RN12	DPS/G1	DEV	TURN
BETA1C	A12/A11						
1.786	.885	.693	1.565	.346	1.461	1.222	.162
.038	.466	1.727	.601	1.240	.526	4.819	39.497
33.753	.437						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	P12/R11	T12/T11	OMEGA
TPLP	DE	DE/EO	DV/Y	RN12	DPS/G1	DEV	TURN
BETA1C	A12/A11						
1.891	.868	.645	1.425	.348	1.514	1.249	.185
.043	.513	1.854	.600	1.177	.596	7.191	37.125
30.520	.464						

STREAMLINE NO.10 - 3 TO 1 STAGE

AIRFLOW

BLADE

▲ P.S.

○ S.S.

□ T.E.

SPLITTER

* P.S.

★ S.S.

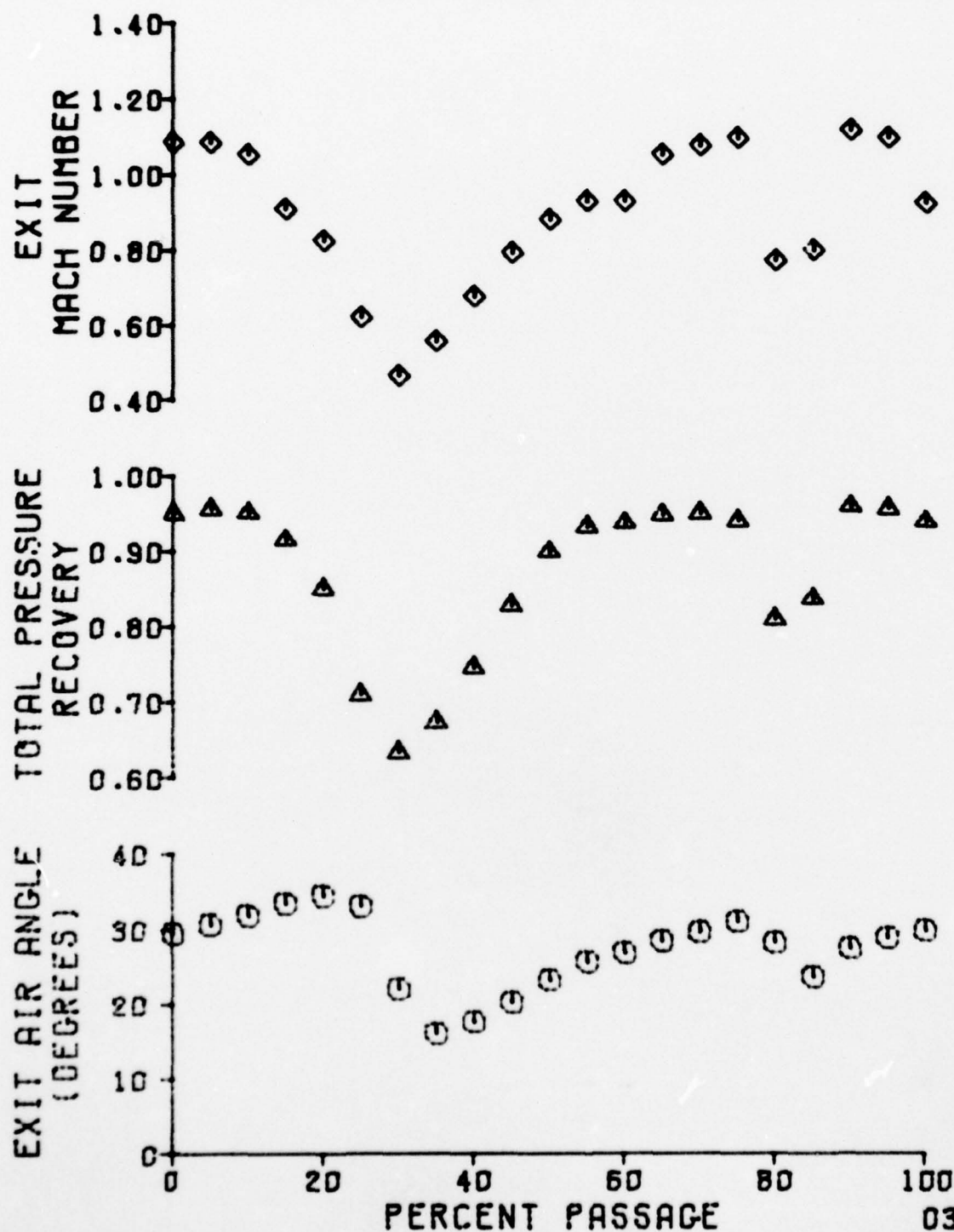
PRESSURE RISE COEFFICIENT(P-P1)/Q1

1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40

INLET MACH NUMBER = 1.461
STATIC PRESSURE RATIO = 1.786
PERCENT CHORD 0 20 40 60 80 100
03/02/77

SUPERSONIC COMPRESSOR CASCADE ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.786



03/02/77

62591

345



326853

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.786

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.727	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.870	1.501	57.970	24.294	565.562

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.144	43.076	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

IAL (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	19.954	19.967	19.959	19.979
	11	18.539	6.641	6.782	1.713
	13	11.433	8.341	9.937	5.356
	15	11.807	9.383	11.906	5.469
	17	11.587	14.561	11.227	5.732
	19	11.675	10.796	9.780	7.030
	21	19.901	9.244	8.933	7.478
	23	10.019	14.564	9.171	6.351
	25	10.101	9.249	11.271	9.141
	27	10.380	12.071	11.844	9.524
	29	10.295	10.453	10.809	9.691
	31	10.110	14.574	10.192	10.093
	33	10.356	10.013	10.189	2.028
	35	10.094	11.067	10.185	1.875
	37	10.112	10.214	10.183	1.599
	39	10.226	14.556	10.145	1.491
	41	10.621	10.964	10.145	1.761
	43	19.972	14.567	12.359	8.953
	45	5.020	20.001	12.580	5.384
	47	19.976	19.994	20.003	5.382

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SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	45%

2

SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.804	1.581	.236	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.520	19.944	565.562	8.991	65.706

CASCADE INLET CONDITIONS

NN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.461	19.943	565.562	66.850	5.746	.241	8.586
1)SS	1)ML	NN)X,1	NN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.343	1.427	3.471	1.423

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.019	33	10.356
25	10.101	35	10.094
27	10.380	37	10.112
29	10.295	39	10.226
31	10.110	41	10.621


MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
10.161	.134	10.282	.194	1.029	1.772

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.192
		33	10.189
		35	10.185
		37	10.183
		39	10.145
		41	10.145

MEAN TRAILING EDGE PRESSURE (PSIA) 10.173 RMS DEVIATION .020



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.028 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	1.875 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.599 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.491 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.459 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.761 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.048 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.300 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.782	5.356	.354	-.046	.440	.269	13.69	13.45
13	9.937	5.356	.488	-.046	.498	.269	26.98	26.63
15	11.906	5.469	.717	-.032	.597	.274	39.60	39.24
17	11.227	5.732	.638	-.002	.563	.287	49.07	48.78
19	9.780	7.030	.470	.149	.490	.352	57.88	57.75
21	8.933	7.478	.371	.202	.448	.375	66.00	66.09
23	9.171	8.351	.399	.303	.460	.419	73.41	73.77
25	11.271	9.141	.643	.395	.565	.458	81.70	82.41
27	11.844	9.524	.710	.440	.594	.478	89.05	89.97
29	10.809	9.901	.590	.494	.542	.501	96.93	97.73
31	10.164	10.164	.514	.514	.510	.510	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	FC)LE	CP)LE
.352	-.291	.198	-34.252	-.021	.352	.135	38.369

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.359	8.953	.770	.373	.620	.449	95.57	93.37
45	12.680		.808		.635		110.63	
47		5.382		-.042		.270		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	V DEV PT1/P	M12 TURN P1/P	M1X,2 M12 P1/RP	M1Y,2 DP11,2 P1/RP	PT12 V12 P1/SP	P12 PT10 BETA1/P	PT12/PT11 PT10 PT11	BETA12 PT10, A 1111
.20	6.284 6.528 18.985	.929 37.788 11.425	.912 .000 12.046	.452 .958 11.646	18.985 1000.523 11.852	10.868 20.002 -2.928	.952 19.953 19.977	29.062 19.978 565.217
5.20	6.363 8.000 18.986	1.053 36.316 11.490	.907 .029 11.832	.535 .954 11.643	18.989 1110.517 11.752	9.420 19.955 -1.456	.952 19.953 19.954	30.534 19.954 565.217
9.00	6.442 8.958 18.992	1.053 35.358 11.545	.898 .029 11.662	.550 .948 11.676	18.996 1110.517 11.675	9.423 19.952 -1.498	.952 19.932 19.941	31.492 19.942 565.217
14.00	6.521 10.771 18.477	.918 33.545 11.632	.767 .028 11.363	.504 1.466 11.551	18.477 989.565 11.542	10.717 19.982 1.315	.926 19.936 19.959	33.305 19.959 565.562
19.00	6.600 11.765 17.317	.846 32.551 11.527	.699 .026 11.121	.477 2.626 11.336	17.317 922.250 11.303	10.844 20.041 2.309	.868 19.968 20.014	34.200 20.015 565.562
24.98	6.679 11.299 14.504	.844 33.017 11.320	.535 .022 11.129	.358 5.440 11.007	14.504 720.904 10.895	10.977 19.977 1.843	.727 19.929 19.952	33.833 19.953 565.562
29.98	6.758 -1.412 12.668	.464 44.728 10.975	.430 .017 11.481	.175 7.275 10.817	12.668 529.700 10.701	10.930 19.978 -9.868	.635 19.910 19.944	22.122 19.944 565.562

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT1YP	MN12 TURN P11P	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/P111 PT10 PT11	BETA12 PT10,4 TT11
02 A 1									
62 78 17	35.04	6.838 -5.870 13.446	.547 50.186 10.771	.524 .017 11.897	.157 6.497 10.719	13.446 618.948 10.615	10.974 19.990 -15.316	.674 19.976 19.983	16.664 19.983 565.562
34 54 17	40.04	6.917 -4.641 14.929	.675 48.957 10.601	.642 .020 12.198	.207 5.015 10.706	14.929 753.272 10.761	11.002 19.970 -14.097	.749 19.918 19.944	17.893 19.944 565.562
42 42 17	45.04	6.996 -2.187 16.601	.786 46.483 10.587	.737 .024 12.377	.274 3.342 10.915	16.601 864.754 11.192	11.038 20.105 -11.613	.832 20.050 20.077	20.367 20.078 565.217
05 59 562	50.03	7.075 .781 17.892	.874 43.535 10.694	.803 .027 12.318	.346 2.051 11.166	17.892 949.203 11.521	10.875 19.998 -8.675	.897 19.940 19.968	23.315 19.969 565.562
09 15 562	55.03	7.154 3.507 18.684	.925 40.809 11.009	.831 .029 12.239	.406 1.279 11.420	18.664 996.019 11.619	10.742 19.990 -5.949	.936 20.045 20.017	26.041 20.017 565.562
33 53 562	60.03	7.233 4.236 18.718	.924 40.080 11.175	.825 .029 12.258	.416 1.225 11.512	18.718 995.843 11.618	10.776 19.990 -5.220	.939 19.959 19.974	26.770 19.975 565.217
122 944 562	65.02	7.312 5.272 18.772	.931 39.044 11.196	.823 .029 12.072	.434 1.172 11.518	18.772 1001.834 11.590	10.729 19.949 -4.184	.941 19.911 19.930	27.806 19.930 565.562

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YF	MA)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 EP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.391	1.053	.916	.519	18.899	9.376	.948	29.560
	7.026	37.290	.029	1.044	1110.517	19.952	19.933	19.948
	18.896	11.333	11.902	11.549	11.606	-2.430	19.947	565.562
75.02	7.470	1.081	.926	.559	18.719	8.971	.939	31.126
	8.592	35.724	.029	1.225	1134.792	20.060	20.016	20.038
	18.707	11.333	11.538	11.388	11.433	-1.864	20.038	565.562
80.01	7.549	.757	.673	.348	16.000	10.943	.802	27.356
	4.822	39.494	.026	3.943	836.027	19.947	19.957	19.952
	16.000	11.059	11.718	10.992	10.974	-4.634	19.951	565.217
85.01	7.628	.839	.765	.345	17.219	10.856	.863	24.241
	1.787	42.609	.025	2.725	915.926	19.914	19.891	19.902
	17.219	10.779	12.117	11.078	11.146	-7.749	19.902	565.562
90.01	7.707	1.107	.981	.514	19.049	8.843	.955	27.660
	5.126	39.190	.028	.804	1156.587	19.791	19.840	19.815
	19.024	10.981	12.037	11.411	11.566	-4.330	19.815	565.217
95.00	7.786	1.053	.921	.510	19.004	9.428	.953	28.975
	6.441	37.875	.029	.939	1110.517	19.944	19.922	19.933
	19.001	11.326	12.035	11.597	11.724	-3.015	19.933	565.562
100.00	7.865	.927	.800	.468	18.552	10.648	.930	30.344
	7.810	36.506	.029	1.391	998.314	19.968	19.913	19.940
	18.552	11.321	11.662	11.516	11.647	-1.646	19.940	565.562

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MM2 BETA2 PT2/PT1

.990 27.443 .887

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MMX,2	MMY,2	PT2	P2	TT2	TT2/T2	M2/M1
.798	.415	17.695	10.468	565.562	1.162	1.012

MIXED EXIT CONDITIONS

MMX,2	MMY,2	PT2	P2	TT2	TT2/T2	MM2	BETA2
.729	.413	17.371	10.963	565.562	1.141	.838	29.512

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

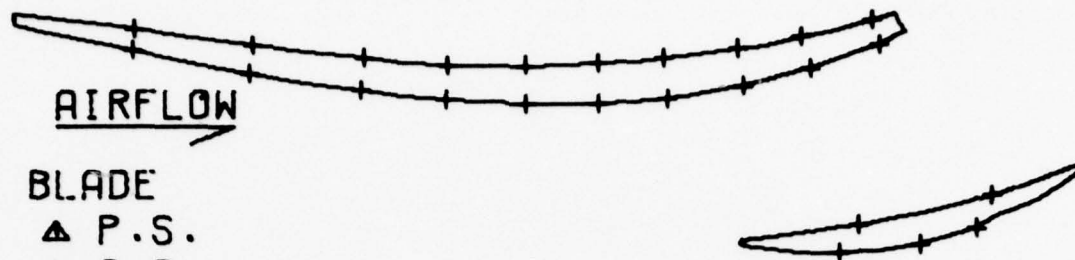
P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEG	DVY	PN2	DPS/Q1	DEV	TURN
BETA(C)	A2/A1						
1.622	.867	.682	1.540	.342	1.483	1.228	.158
.037	.477	1.753	.605	1.234	.550	4.909	39.407
33.765	.438						

OVERALL PERFORMANCE

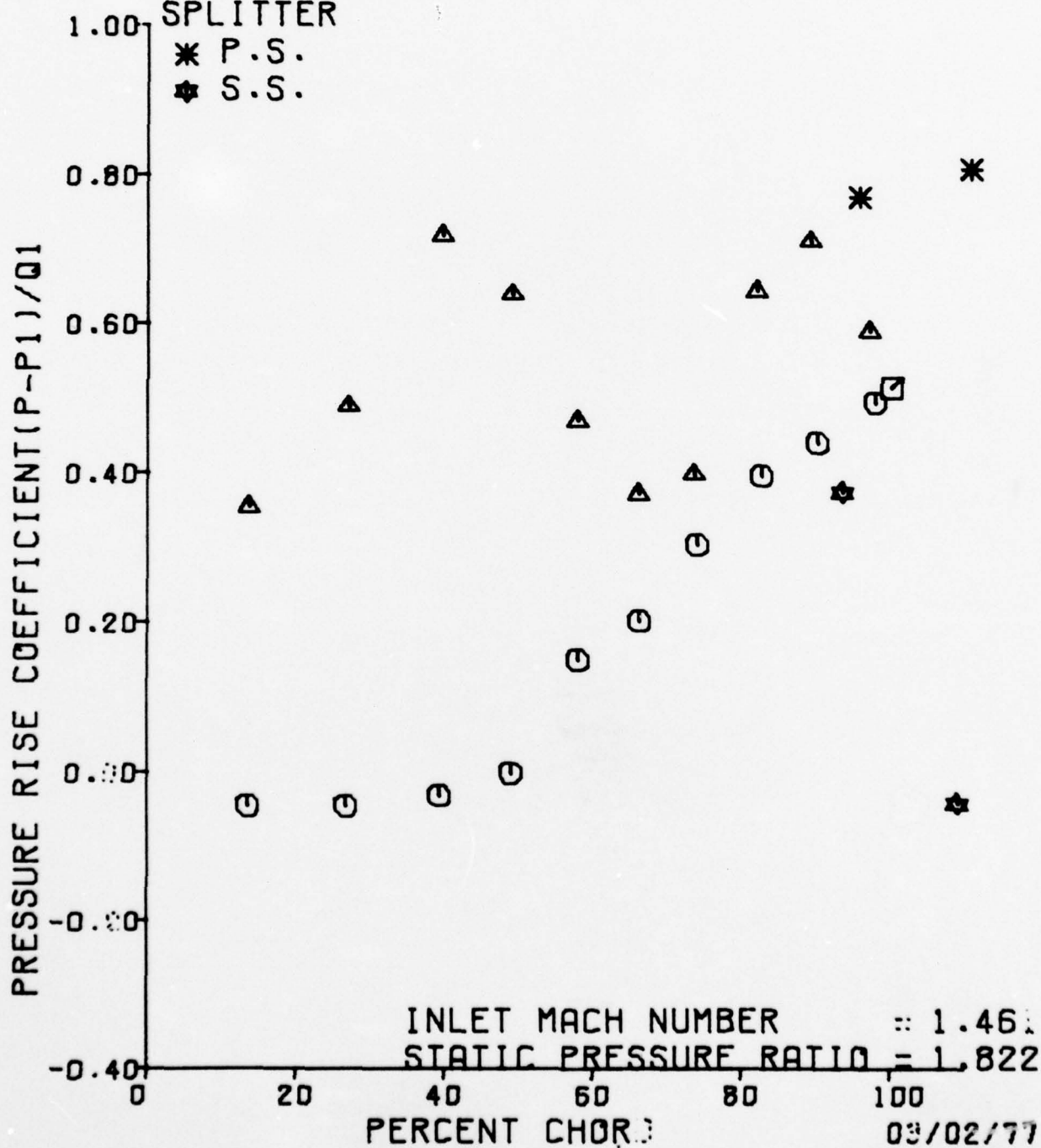
MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DF	DFEG	DVY	PN2	DPS/Q1	DEV	TURN
BETA(C)	A2/A1						
1.908	.871	.542	1.421	.344	1.525	1.251	.181
.041	.517	1.864	.603	1.177	.608	6.978	37.338
30.719	.462						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

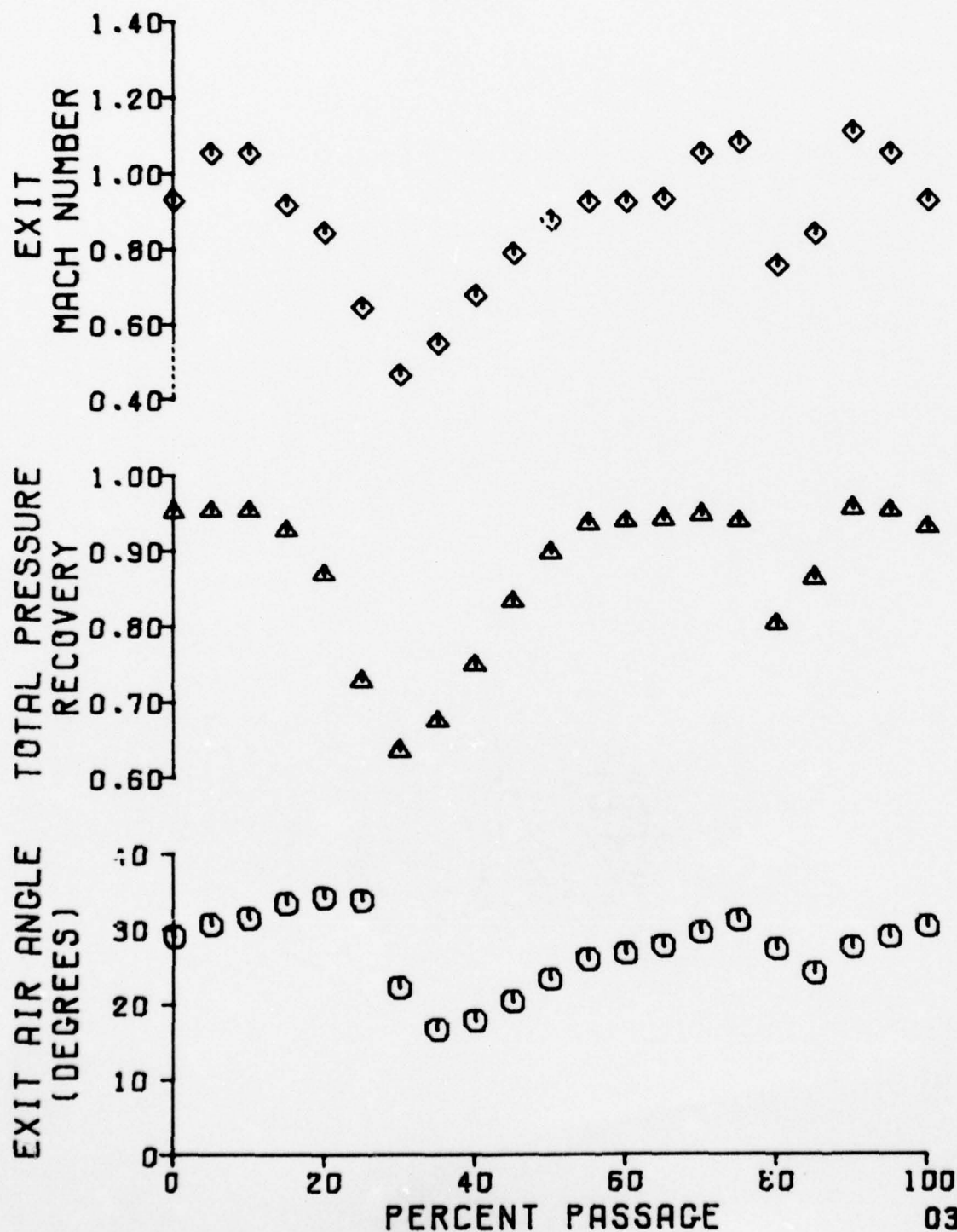


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.822





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CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.822

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.803	4	.400

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.861	1.502	57.900	24.302	565.562

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.151	43.084	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
APL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.977	19.990	19.982	19.978
11	18.456	8.653	9.431	1.662
13	11.474	8.694	10.210	5.364
15	11.943	9.678	11.957	5.585
17	11.684	14.552	11.223	6.028
19	11.770	10.992	9.792	6.926
21	19.918	9.419	8.979	7.878
23	10.229	14.552	9.616	8.714
25	10.276	9.412	11.557	9.382
27	10.520	12.244	12.022	9.777
29	10.433	10.661	11.022	10.234
31	10.273	14.564	10.455	20.003
33	10.558	10.403	10.448	1.980
35	10.254	11.243	10.441	1.880
37	10.276	10.422	10.437	1.547
39	10.414	14.549	10.379	1.420
41	10.776	11.136	10.370	1.712
43	19.965	14.555	12.426	8.952
45	5.066	10.987	12.776	5.660
47	19.992	19.994	20.009	5.659

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	45%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.024	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN10	PT10	TT10	M10	BETA10
1.500	19.962	565.562	2.999	65.698

CASCADE INLET CONDITIONS

PN11	PT11	TT11	BETA11	P11	M11	Q11
1.461	19.961	565.562	66.850	5.754	.241	8.594
ISS	ISML	PN1Y,1	PN1Y,1	TT/111	PT/P11	NR/10**6
1.371	3.482	.574	1.343	1.427	3.469	1.424

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.229	33	10.558
25	10.276	35	10.254
27	10.529	37	10.276
29	10.433	39	10.414
31	10.273	41	10.776

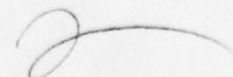
MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.348	.114	10.456	.194	1.016	1.799

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.455
		33	10.448
		35	10.441
		37	10.437
		39	10.379
		41	10.370

MEAN TRAILING EDGE PRESSURE (PSIA) 10.422 RMS DEVIATION .034



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.980 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	1.880 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.547 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.420 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.459 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.712 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.302 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.431	5.364	.428	-.045	.472	.269	13.69	13.45
13	10.210	5.364	.519	-.045	.512	.269	26.98	26.63
15	11.957	5.585	.722	-.020	.599	.280	39.60	39.24
17	11.223	6.028	.636	.032	.562	.302	49.27	48.78
19	9.792	6.926	.470	.136	.491	.347	57.88	57.75
21	8.979	7.878	.375	.247	.450	.395	66.30	66.29
23	9.616	8.714	.449	.344	.482	.437	73.41	73.77
25	11.557	9.382	.675	.422	.579	.470	81.70	82.41
27	12.022	9.777	.729	.468	.602	.490	89.05	89.97
29	11.022	10.234	.613	.521	.552	.513	96.93	97.73
0	10.408	10.408	.542	.542	.521	.521	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC1LE	CP1LE
.363	-.301	.202	-33.903	-.024	.362	.134	37.061

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.426	8.952	.776	.372	.623	.448	95.57	93.37
45	12.776		.817		.640		110.63	
47		8.659		-.011		.283		100.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TF	MN)Y,2 M)2 P)BP	MN)Y,2 CP)1,2 P)NF	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,4 T)1
.00	6.284	.929	.814	.448	18.869	10.808	.945	28.808
	6.274	36.842	.002	1.002	1000.042	20.000	19.952	19.976
	18.869	11.326	12.007	11.586	11.773	-3.232	19.976	565.562
5.00	6.363	.929	.801	.471	19.003	10.880	.952	30.449
	7.915	36.401	.029	.959	1000.377	19.989	19.944	19.966
	19.003	11.566	11.903	11.755	11.807	-1.591	19.966	565.562
9.99	6.442	.911	.774	.481	18.709	10.927	.937	31.845
	9.311	35.005	.028	1.252	983.692	20.023	19.970	19.906
	18.709	11.651	11.691	11.712	11.755	-.195	19.996	565.562
14.99	6.521	.862	.722	.471	17.833	10.985	.893	33.122
	10.588	33.728	.027	2.128	937.221	19.963	19.847	19.905
	17.833	11.618	11.418	11.551	11.577	1.082	19.904	565.562
19.99	6.600	.794	.658	.445	16.703	11.018	.837	34.056
	11.522	32.794	.025	3.259	872.591	19.902	19.829	19.865
	16.703	11.497	11.178	11.292	11.334	2.016	19.865	565.562
24.98	6.679	.610	.512	.331	14.273	11.102	.715	32.871
	10.337	33.979	.021	5.688	685.991	20.031	19.975	20.003
	14.273	11.377	11.299	11.108	11.024	.831	20.002	565.907
29.98	6.758	.454	.430	.145	12.779	11.092	.640	18.680
	-3.854	48.170	.016	7.183	518.938	19.999	19.951	19.975
	12.779	11.056	11.716	10.941	10.863	-13.350	19.974	565.562

18581

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 0, A 1)1	PERCT	Y DEV PT)YP	HN)2 TURN P)TP	HN)X,2 M)2 P)RP	HN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0, A 1)1
.808 .976 .562	35.24	6.838 -5.365 13.697	.541 49.681 11.948	.517 .017 12.142	.160 6.264 10.908	13.697 612.931 10.912	11.225 19.938 -14.871	.686 19.880 19.909	17.169 19.909 565.562
.449 .966 .562	40.24	6.917 -3.948 15.026	.563 48.264 10.813	.529 .020 12.308	.211 4.935 10.914	15.026 741.160 10.977	11.187 20.025 -13.444	.753 19.981 20.002	18.586 20.023 565.562
.845 .906 .562	45.24	6.996 -1.900 16.573	.772 46.216 10.724	.723 .024 12.439	.272 3.388 11.030	16.573 850.962 11.307	11.171 20.018 -11.406	.830 19.962 19.989	20.634 19.997 565.562
.122 .905 .562	50.23	7.075 1.157 17.952	.863 43.159 10.901	.790 .027 12.446	.347 2.010 11.303	17.952 938.387 11.638	11.044 20.001 -8.349	.899 19.944 19.972	23.691 19.973 565.562
.056 .865 .562	55.23	7.154 3.263 18.556	.906 41.053 11.073	.816 .029 12.331	.394 1.405 11.504	18.556 978.838 11.666	10.900 19.948 -6.233	.930 19.909 19.928	25.797 19.929 565.562
.871 .003 .907	60.23	7.233 4.579 18.604	.906 39.737 11.278	.806 .029 12.274	.413 1.358 11.589	18.604 978.838 11.689	10.928 19.975 -4.917	.932 19.923 19.948	27.113 19.949 565.562
.680 .975 .562	65.22	7.312 5.467 18.834	.906 38.849 11.497	.800 .029 12.323	.425 1.127 11.754	18.834 978.838 11.845	11.063 20.170 -4.029	.944 20.099 20.134	28.001 20.135 565.562

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	KN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.391 6.860 18.689	.925 37.456 11.378	.806 .029 11.927	.454 1.272 11.556	18.689 998.468 11.659	10.751 20.012 -2.546	.936 19.953 19.982	29.394 19.982 565.562
75.02	7.470 8.197 18.295	.906 36.119 11.368	.779 .028 11.828	.463 1.666 11.409	18.295 978.838 11.496	10.747 19.938 -1.299	.917 19.895 19.916	30.731 19.917 565.562
80.21	7.549 4.562 15.900	.730 39.754 11.183	.650 .025 11.849	.332 4.061 11.105	15.900 808.866 11.152	11.155 19.980 -4.944	.797 19.943 19.961	27.096 19.961 565.562
85.01	7.628 2.046 17.206	.820 42.270 10.941	.746 .025 12.196	.341 2.756 11.201	17.206 897.833 11.294	11.059 19.900 -7.450	.862 19.893 19.896	24.580 19.896 565.562
90.21	7.707 5.152 19.046	1.053 39.164 11.166	.932 .028 12.192	.489 .912 11.553	19.050 1110.517 11.702	9.450 19.977 -4.344	.954 19.934 19.955	27.666 19.956 565.562
95.00	7.786 6.253 18.898	.926 38.053 11.347	.812 .029 12.028	.446 1.103 11.623	18.858 997.531 11.750	10.834 20.028 -3.243	.945 19.973 20.000	28.797 20.001 565.562
100.00	7.865 7.188 18.387	.885 37.128 11.477	.768 .028 11.931	.439 1.574 11.644	18.387 958.880 11.729	11.054 19.966 -2.318	.921 19.926 19.955	29.722 19.956 565.562

62581

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

BETA)2
PT)0,A
TT)1

MN)2 BETA)2 PT)2/PT)1

.842 27.298 .880

29.304
19.982
65.562

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

30.731
19.917
65.562

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	M)2/M)1
.749	.386	17.563	11.036	565.562	1.142	.999

27.096
19.961
65.562

MIXED EXIT CONDITIONS

24.582
19.806
65.562

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)1	MN)2	BETA)1
.702	.386	17.265	11.311	565.562	1.128	.801	28.79

27.686
19.956
65.562

28.797
20.001
65.562

29.722
19.956
65.562

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	FN)2	DPS/O1	DEV	TURN
BETA)C	A)2/A)1						
1.918	.889	.645	1.457	.322	1.535	1.249	.169
.839	.528	1.862	.624	1.193	.615	4.764	39.552
31.781	.447						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EG	DV)Y	FN)2	DPS/O1	DEV	TURN
BETA)C	A)2/A)1						
1.966	.865	.617	1.375	.323	1.555	1.264	.190
.844	.547	1.943	.622	1.146	.647	6.264	38.052
28.693	.468						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

AIRFLOW

BLADE

▲ P.S.

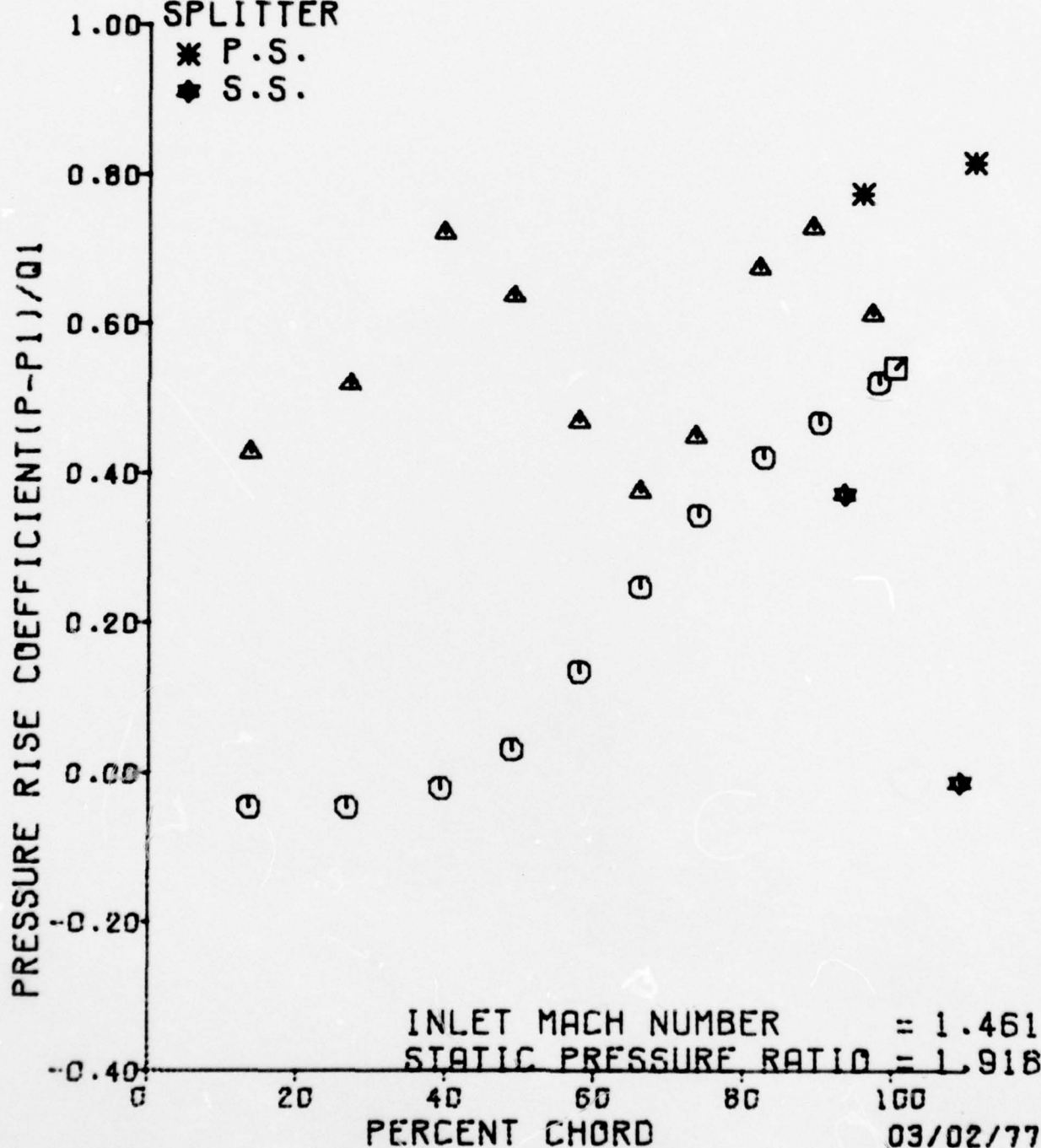
○ S.S.

◻ T.E.

SPLITTER

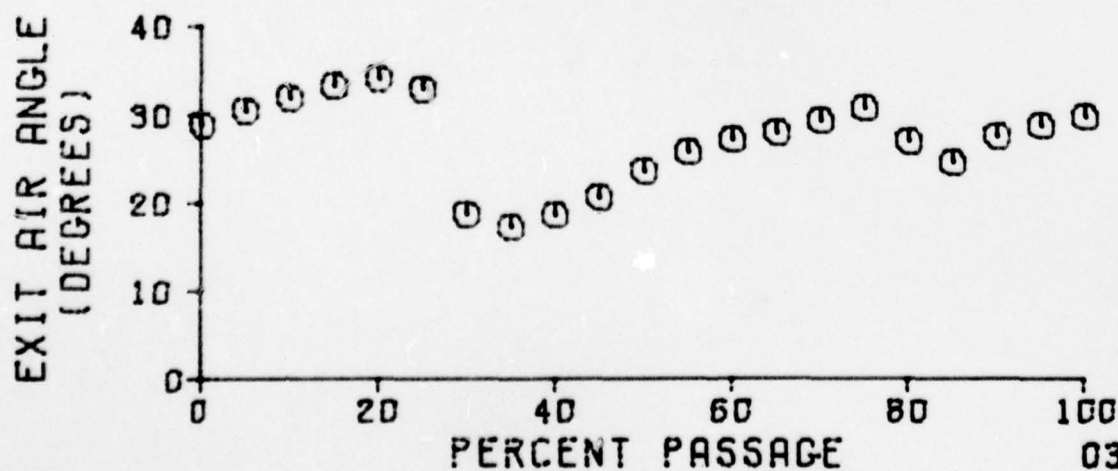
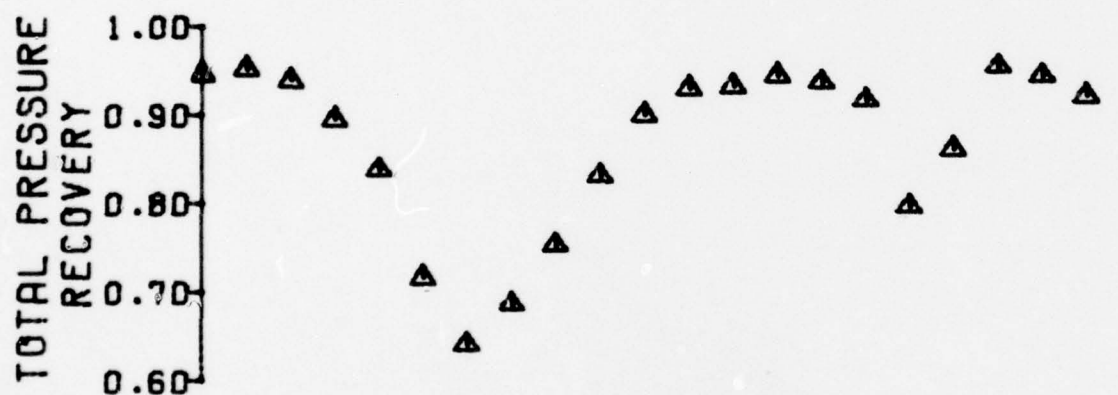
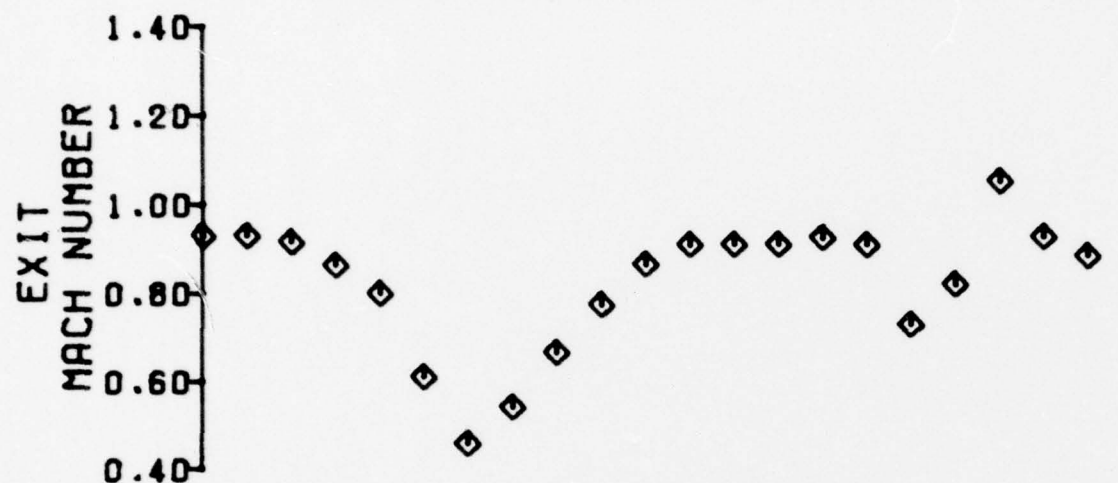
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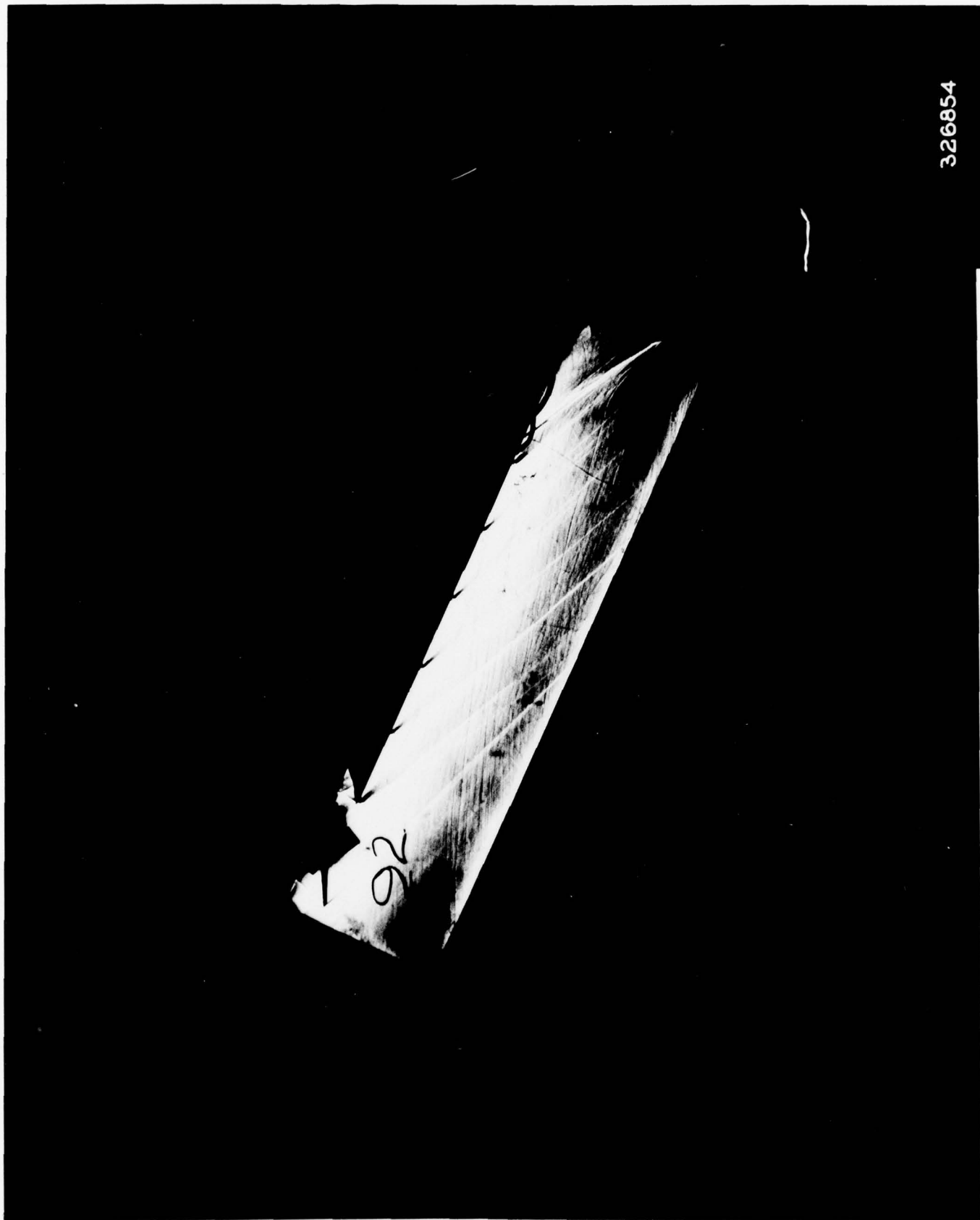
★ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES. = 0.490
CASCADE INLET MACH NUMBER = 1.461
CASCADE STATIC PRESSURE RATIO = 1.918





326854

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.918

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.461	1.856	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.501	57.960	24.290	565.217

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.140	43.071	1.461	1.000	1.058

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.961	10.978	10.973	10.993
11	10.329	6.660	10.277	1.666
13	11.637	9.454	10.694	5.411
15	12.118	10.012	12.019	5.710
17	11.815	14.559	11.199	6.593
19	11.962	11.262	9.774	7.396
21	10.924	9.889	9.051	8.521
23	10.523	14.562	10.343	9.271
25	10.570	9.874	11.926	9.770
27	10.764	12.536	12.293	10.194
29	10.716	10.975	11.339	10.663
31	10.559	14.571	10.825	20.039
33	10.877	10.973	10.826	1.984
35	10.572	11.521	10.818	1.908
37	10.594	10.742	10.813	1.551
39	10.696	14.555	10.799	1.425
41	11.044	11.420	10.790	1.711
43	10.994	14.564	12.509	8.962
45	4.998	10.990	12.958	6.488
47	10.935	10.963	10.983	6.484

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	45%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN10	PT10	TT10	M10	BETA10
1.520	19.933	565.217	8.989	65.710

CASCADE INLET CONDITIONS

PN11	PT11	TT11	BETA11	P11	M11	Q11
1.461	19.933	565.217	66.850	5.742	.241	8.582
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T11	PT/P11	NR/10**6
1.371	3.402	.574	1.344	1.427	3.471	1.423

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.523	33	10.877
25	10.570	35	10.572
27	10.764	37	10.594
29	10.716	39	10.696
31	10.569	41	11.044

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P12/P11)
10.628	.094	10.757	.180	.992	1.851

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.825
		33	10.826
		35	10.818
		37	10.813
		39	10.799
		41	10.790

MEAN TRAILING EDGE PRESSURE (PSIA) 10.812 RMS DEVIATION .013

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	1.984 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	1.908 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.551 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.425 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	552.459 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.711 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.045 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.287 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.069

11
13
15
17
19
21
23
25
27
29
31

43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.277	5.411	.528	-.039	.516	.271	13.69	13.45
13	10.694	5.411	.577	-.039	.536	.271	26.98	26.63
15	12.019	5.710	.731	-.004	.603	.286	39.60	39.24
17	11.199	6.593	.636	.099	.562	.331	49.07	48.78
19	9.774	7.396	.470	.193	.490	.371	57.88	57.75
21	9.051	8.531	.386	.324	.454	.428	66.00	66.09
23	10.343	9.271	.536	.411	.519	.465	73.41	73.77
25	11.906	9.770	.718	.469	.597	.498	81.70	82.41
27	12.293	10.194	.763	.519	.617	.511	89.85	89.97
29	11.339	10.663	.652	.573	.569	.535	96.93	97.73
0	10.806	10.806	.590	.590	.542	.542	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC1E	CP1E
.368	-.308	.203	-33.364	-.028	.367	.128	34.782

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.509	8.962	.789	.375	.628	.450	95.57	93.37
45	12.958		.841		.650		110.63	
47		8.484		.086		.325		100.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN PT)P	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
.00	6.284 6.421 19.098	.911 37.895 11.511	.797 .000 12.255	.441 .835 11.879	19.098 983.374 12.017	11.155 20.042 -3.075	.958 20.102 20.072	28.955 20.072 565.562
5.00	6.353 7.661 18.745	.890 36.555 11.592	.769 .029 12.061	.448 1.188 11.867	18.745 963.793 11.925	11.202 19.891 -1.835	.940 19.931 19.910	30.195 19.911 565.217
9.99	6.442 8.894 18.291	.861 35.422 11.779	.734 .028 11.893	.449 1.642 11.837	18.291 936.010 11.872	11.279 19.985 -1.602	.918 19.967 19.975	31.428 19.976 565.562
4.99	6.521 9.875 17.412	.802 34.441 11.742	.677 .026 11.678	.430 2.521 11.756	17.412 879.646 11.791	11.401 20.000 .379	.874 19.967 19.983	32.409 19.984 565.562
19.99	6.600 10.566 16.452	.743 33.748 11.672	.623 .024 11.519	.406 3.481 11.623	16.452 821.854 11.668	11.401 19.989 1.072	.825 19.939 19.964	33.102 19.964 565.562
24.98	6.679 10.180 14.372	.586 34.136 11.504	.493 .020 11.544	.317 5.561 11.433	14.372 660.378 11.363	11.392 19.902 .674	.721 19.933 19.962	32.714 19.962 565.562
29.98	6.758 -1.438 13.059	.454 44.754 11.360	.421 .016 11.864	.171 6.874 11.263	13.059 518.914 11.109	11.334 20.003 -9.934	.655 19.945 19.973	22.096 19.974 565.562

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

ETA)2 T)0,A T)1	PERCT	Y DFV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 DF)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
8.955 0.072 5.562	35.04	6.838 -4.232 13.765	.531 48.548 11.174	.504 .017 12.156	.167 6.168 11.148	13.765 602.006 11.091	11.361 19.948 -13.728	.691 19.934 19.941	18.302 19.941 565.562
0.195 9.911 5.217	40.04	6.917 -2.397 15.056	.648 46.713 11.056	.608 .020 12.339	.223 4.877 11.889	15.056 725.049 11.236	11.356 19.927 -11.893	.755 19.919 19.922	20.137 19.923 565.562
1.428 9.976 5.562	45.04	6.996 -1.311 16.427	.735 45.627 11.045	.685 .024 12.557	.266 3.595 11.312	16.427 813.518 11.547	11.473 19.952 -10.807	.824 19.925 19.938	21.223 19.939 565.217
2.409 9.984 5.562	50.03	7.075 1.751 17.781	.828 42.565 11.136	.755 .027 12.495	.341 2.152 11.530	17.781 905.124 11.770	11.338 19.920 -7.745	.892 19.879 19.899	24.285 19.899 565.217
3.122 9.984 5.562	55.03	7.154 3.777 18.571	.885 40.539 11.296	.793 .028 12.423	.392 1.362 11.631	18.571 958.588 11.867	11.164 20.004 -5.719	.932 19.974 19.989	26.311 19.989 565.217
2.714 9.962 5.562	60.03	7.233 5.099 18.548	.879 39.217 11.471	.770 .029 12.333	.408 1.385 11.682	18.548 983.437 11.868	11.216 19.909 -4.407	.931 19.856 19.882	27.633 19.883 565.562
2.096 9.974 5.562	65.02	7.312 5.759 18.329	.862 38.557 11.542	.759 .028 12.249	.408 1.604 11.749	18.329 937.123 11.872	11.288 19.929 -3.737	.920 19.901 19.915	28.293 19.915 565.562

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YF	MN)2 TURN P)TP	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.22	7.391 6.704 18.310	.863 37.612 11.560	.753 .028 12.089	.422 1.523 11.737	18.310 938.430 11.828	11.260 20.120 -2.792	.910 20.070 20.095	29.238 20.093 565.217
75.22	7.470 5.813 17.775	.854 38.503 11.192	.751 .027 11.861	.405 2.158 11.562	17.775 929.257 11.618	11.242 19.894 -3.683	.892 19.779 19.836	28.347 19.836 565.217
80.21	7.549 4.441 15.738	.701 39.875 11.328	.625 .025 11.967	.318 4.195 11.249	15.738 779.667 11.369	11.334 19.986 -5.045	.790 19.928 19.957	26.975 19.957 565.562
85.21	7.628 2.369 16.748	.764 41.947 11.240	.693 .024 12.311	.322 3.185 11.391	16.748 842.699 11.468	11.377 20.042 -7.117	.840 19.987 20.014	24.903 20.014 565.562
90.21	7.707 4.023 18.379	.874 40.293 11.255	.782 .027 12.308	.391 1.554 11.572	18.379 948.451 11.819	11.176 19.834 -5.463	.922 19.883 19.858	26.557 19.858 565.562
95.20	7.785 5.845 18.614	.881 38.470 11.506	.775 .029 12.225	.419 1.319 11.792	18.614 954.953 11.966	11.235 19.987 -3.650	.934 19.929 19.957	28.382 19.958 565.562
100.20	7.865 6.911 18.491	.870 37.405 11.633	.757 .028 12.133	.428 1.442 11.803	18.491 944.571 11.946	11.294 20.043 -2.585	.928 19.995 20.018	29.445 20.019 565.217

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MM12 BETA12 PT12/PT11

.797 27.302 .870

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 T112/T12 M12/M11

.708 .366 17.337 11.408 565.217 1.127 .978

MIXED EXIT CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 T112/T12 MM12 BETA12

.673 .365 17.084 11.589 565.217 1.117 .766 28.479

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EG	DV1Y	RN12	DR5/G1	DEV	TURN
BETA1C	A12/A11						
1.987	.872	.614	1.367	.306	1.569	1.266	.183
.843	.554	1.956	.638	1.148	.660	4.768	39.548
29.110	.459						

OVERALL PERFORMANCE

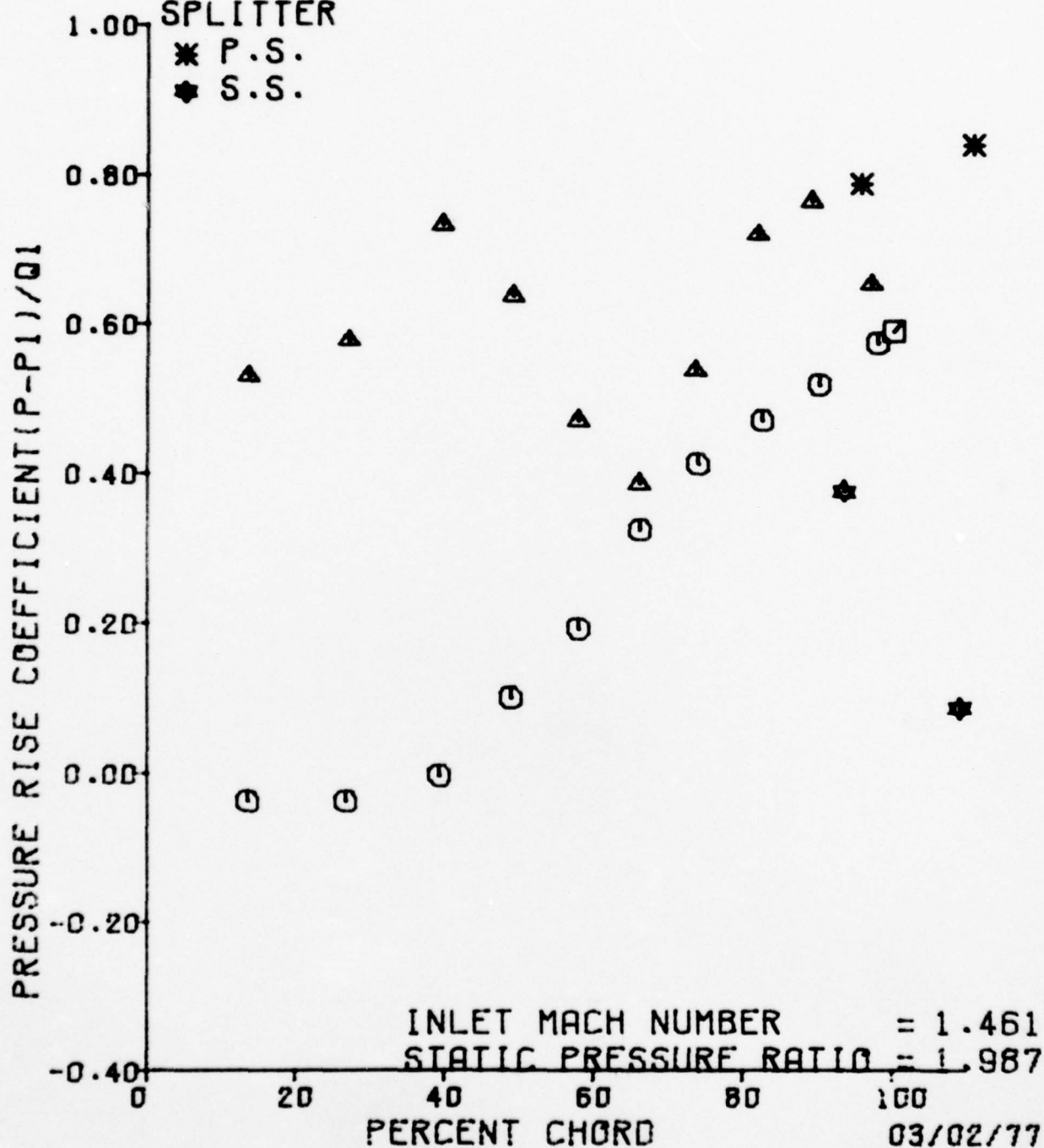
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DE	DE1EG	DV1Y	RN12	DR5/G1	DEV	TURN
BETA1C	A12/A11						
2.018	.857	.592	1.324	.307	1.580	1.277	.201
.846	.575	2.027	.637	1.109	.681	5.945	38.371
25.956	.478						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

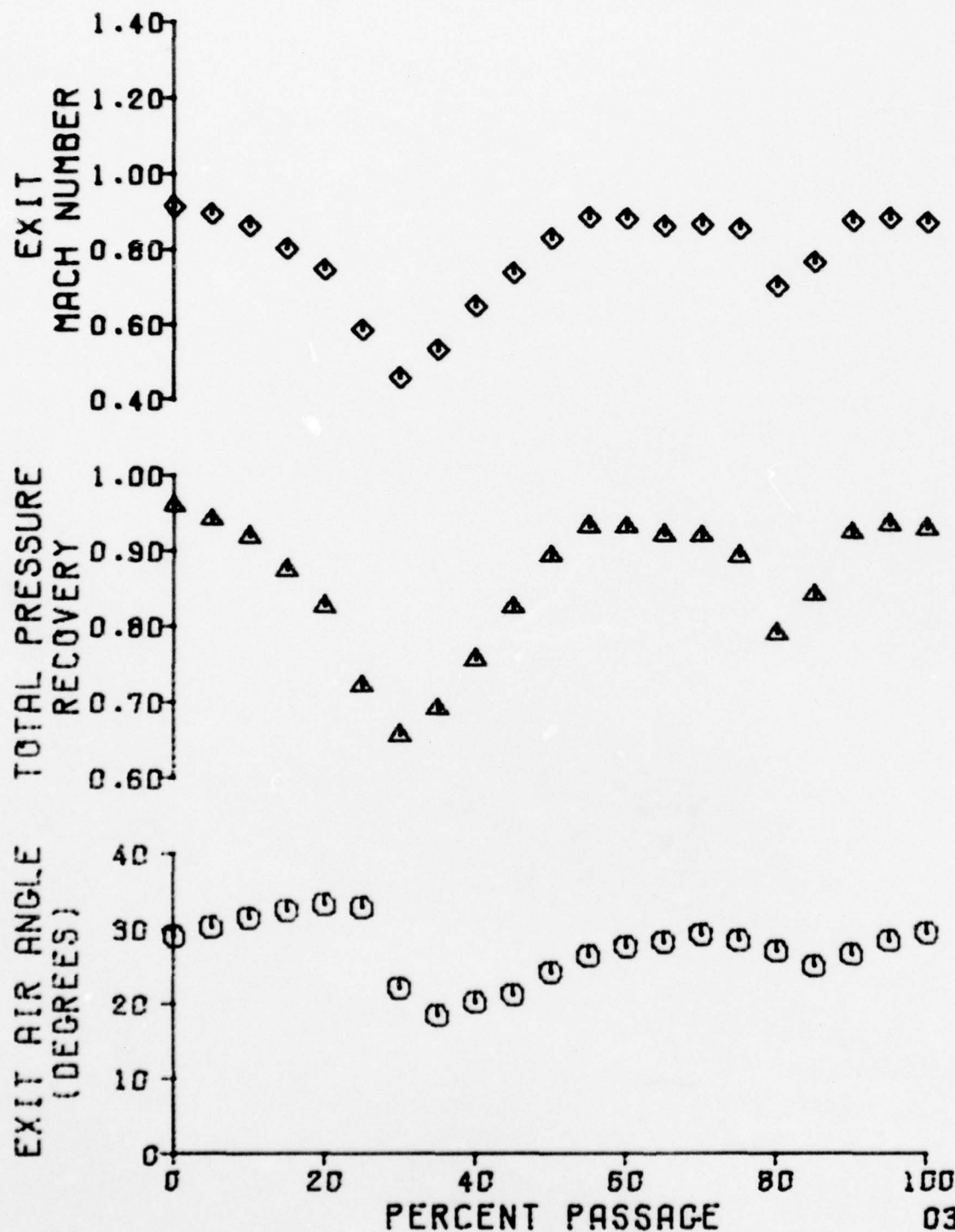


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
 ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
 AXIAL PROBE LOCATION, INCHES, = 0.490
 CASCADE INLET MACH NUMBER = 1.461
 CASCADE STATIC PRESSURE RATIO = 1.987



03/02/77



326855

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.987

APPENDIX I

CASCADE DATA

SPLITTER VANE POSITION = 43%

$$P)_2/P)_1 = 1.707$$

$$P)_2/P)_1 = 1.790$$

$$P)_2/P)_1 = 1.856$$

$$P)_2/P)_1 = 1.917$$

$$P)_2/P)_1 = 1.956$$

$$P)_2/P)_1 = 1.986$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.458	1.716	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.856	1.503	58.030	24.380	562.459

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.228	43.172	1.458	1.000	1.062

374

62591

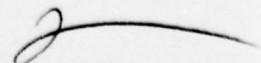
SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.860	19.863	19.848	19.851
11	18.679	6.599	7.213	1.745
13	11.030	8.082	10.112	5.330
15	11.664	8.216	11.715	4.828
17	11.465	14.432	11.149	4.888
19	11.388	10.617	9.626	6.693
21	19.808	9.265	8.581	7.123
23	9.396	14.435	8.452	7.999
25	9.693	9.261	10.271	8.807
27	9.895	11.424	11.315	9.042
29	9.847	10.244	10.263	9.188
31	9.646	14.444	9.624	19.867
33	9.853	8.708	9.618	2.072
35	9.535	10.702	9.610	2.624
37	9.454	9.798	9.608	1.621
39	9.802	14.429	9.256	1.591
41	10.213	10.592	9.253	1.845
43	19.828	14.437	12.127	8.736
45	4.998	19.857	12.260	4.993
47	19.879	19.858	19.858	4.992

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	43%



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.520	19.849	562.459	8.973	65.620

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.458	19.848	562.459	66.850	5.743	.241	8.547
I)SS	I)ML	MN)Y,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.573	1.341	1.425	3.456	1.427

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

(ANE)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.396	33	9.853
25	9.693	35	9.535
27	9.695	37	9.454
29	9.847	39	9.802
31	9.646	41	10.213

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.695	.176	9.772	.268	1.066	1.688

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.624
		33	9.618
		35	9.610
		37	9.608
		39	9.256
		41	9.253

MEAN TRAILING EDGE PRESSURE [PSIA] 9.495 RMS DEVIATION .170

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.070 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.624 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.621 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.591 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	549.010 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.845 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.100 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.435 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.105

11
13
15
17
19
21
23
25
27
29
31

43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.213	5.330	.172	-.048	.353	.269	13.69	13.45
13	10.112	5.330	.511	-.048	.509	.269	26.98	26.63
15	11.715	4.828	.699	-.107	.590	.243	39.60	39.24
17	11.149	4.888	.633	-.100	.562	.246	49.07	48.78
19	9.626	6.693	.454	.111	.485	.337	57.88	57.75
21	8.581	7.123	.332	.161	.432	.359	66.00	66.09
23	8.452	7.999	.317	.264	.426	.403	73.41	73.77
25	10.271	8.807	.530	.359	.517	.444	81.70	82.41
27	11.315	9.242	.852	.386	.570	.456	89.05	89.07
29	10.263	9.188	.529	.403	.517	.463	96.93	97.73
0	9.432	9.432	.432	.432	.475	.475	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CL)1	CL)1	MC)LE	CP)LE
.338	-.279	.192	-34.509	-.019	.338	.136	40.177

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.127	8.736	.747	.350	.611	.440	95.57	93.37
45	12.260		.762		.618		110.63	
47		4.992		-.088		.252		109.00

2

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	MN12 TURN P1TP	MN1Y,2 M12 P1RP	MN1Y,2 [P11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
.30	6.284	.978	.465	.456	17.914	9.704	.903	27.793
	5.256	39.160	.000	1.034	1041.916	19.861	19.823	19.842
	17.914	10.625	11.500	10.830	11.155	-4.170	19.841	562.459
5.40	6.363	1.113	.957	.569	18.886	8.701	.952	30.715
	8.182	36.134	.028	.962	1158.502	19.829	19.807	19.818
	18.887	11.189	11.493	11.364	11.451	-1.254	19.817	562.459
9.99	6.442	1.109	.941	.567	18.830	8.717	.949	31.962
	9.428	34.888	.028	1.018	1155.258	19.866	19.820	19.843
	18.804	11.327	11.329	11.381	11.426	-.008	19.842	562.459
14.99	6.521	.932	.777	.514	18.221	10.402	.918	33.503
	10.960	33.347	.027	1.627	1000.019	19.855	19.806	19.830
	18.221	11.367	11.054	11.297	11.302	1.533	19.829	562.459
19.99	6.600	.863	.707	.495	17.190	10.571	.866	34.963
	12.429	31.887	.025	2.656	935.146	19.860	19.807	19.834
	17.190	11.315	10.780	11.075	11.061	2.993	19.833	562.459
24.98	6.679	.747	.609	.432	15.388	10.628	.775	35.324
	12.790	31.526	.023	4.460	823.414	19.871	19.812	19.842
	15.388	11.164	10.711	10.770	10.708	3.354	19.841	562.459
29.98	6.758	.478	.421	.227	12.426	10.625	.626	28.307
	5.773	38.543	.017	7.422	543.848	19.876	19.818	19.847
	12.426	10.844	11.040	10.503	10.415	-3.663	19.846	562.459

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YR	MN)2 TURN P)TR	MN)Y,2 M)2 P)RP	MN)Y,2 DP)1,2 P)MP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,4 T)11
35.24	6.838 -8.735 12.688	.502 53.851 10.531	.488 .015 11.612	.122 7.160 10.381	12.588 569.471 10.208	10.682 19.853 -18.171	.639 19.828 19.839	13.799 19.840 562.459
40.24	6.917 -5.413 14.687	.626 49.729 10.369	.556 .019 12.062	.202 5.151 10.388	14.687 762.477 10.306	10.720 19.836 -14.849	.740 19.810 19.823	17.121 19.823 562.803
45.24	6.996 -2.051 16.810	.538 46.377 10.325	.785 .025 12.253	.203 3.038 10.682	16.810 912.657 10.673	10.607 19.880 -11.407	.847 19.814 19.846	20.473 19.847 562.459
50.23	7.075 1.269 18.228	.951 43.847 10.483	.879 .028 12.189	.388 1.620 11.038	18.228 1026.317 11.131	10.073 19.873 -8.167	.918 19.814 19.843	23.803 19.844 562.803
55.23	7.154 3.868 18.692	1.087 40.448 10.751	.974 .030 12.068	.483 1.142 11.240	18.706 1136.675 11.364	8.900 19.904 -5.568	.942 19.850 19.875	26.402 19.877 562.459
60.23	7.233 5.241 18.752	1.088 39.075 10.950	.953 .029 11.947	.507 1.072 11.274	18.776 1137.201 11.408	8.927 19.880 -4.195	.946 19.829 19.853	27.775 19.854 562.459
65.22	7.312 5.941 18.725	1.097 38.375 11.030	.954 .029 11.865	.523 1.105 11.261	18.743 1144.741 11.432	8.813 19.882 -3.495	.944 19.833 19.857	28.475 19.858 562.803

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YP	PN12 TURN PT1P	MN1Y,2 M12 P1BP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A T111
70.72	7.391 6.777 18.825	1.113 37.539 11.989	.971 .929 11.733	.545 .995 11.241	18.853 1158.411 11.341	8.687 19.866 -2.659	.950 19.821 19.843	29.311 19.844 562.803
75.82	7.470 8.028 18.499	1.108 36.286 11.042	.954 .928 11.377	.563 1.324 11.118	18.524 1154.112 11.215	8.590 19.853 -1.408	.933 19.799 19.825	30.562 19.826 562.803
80.81	7.549 8.298 17.276	.895 36.018 10.900	.768 .927 11.112	.458 2.572 10.785	17.276 955.516 10.909	10.275 19.850 -1.138	.870 19.808 19.828	30.832 19.829 562.459
85.21	7.628 1.865 15.200	.726 42.451 10.560	.661 .924 11.530	.300 4.648 10.526	15.200 802.620 10.756	10.704 19.846 -7.581	.766 19.806 19.825	24.399 19.826 562.803
90.21	7.707 2.167 17.479	.885 42.149 10.521	.804 .925 11.870	.370 2.359 10.835	17.479 956.245 11.107	10.508 19.860 -7.269	.881 19.818 19.843	24.701 19.844 562.803
95.20	7.786 5.226 18.847	1.117 39.000 10.786	.988 .929 11.809	.520 .970 11.316	18.878 1161.664 11.322	8.656 19.862 -4.210	.951 19.810 19.835	27.760 19.836 562.803
100.20	7.865 6.861 18.700	1.097 37.455 11.044	.956 .929 11.659	.539 1.130 11.460	18.719 1145.187 11.374	8.796 19.844 -2.575	.943 19.806 19.824	29.395 19.825 562.803

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.950 27.684 .883

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 MN2/M11

.841 .441 17.528 9.885 562.459 1.181 1.004

MIXED EXIT CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 MN12 BETA12

.746 .437 17.195 10.563 562.458 1.149 .864 30.357

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	CF	DEFED	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.727	.883	.716	1.613	.362	1.414	1.207	.164
.038	.438	1.668	.587	1.255	.475	5.150	39.166
33.612	.438						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	CF	DEFED	DV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.839	.866	.660	1.449	.363	1.483	1.240	.188
.043	.494	1.809	.586	1.189	.564	7.823	36.493
30.755	.465						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

AIRFLOW

BLADE

▲ P.S.

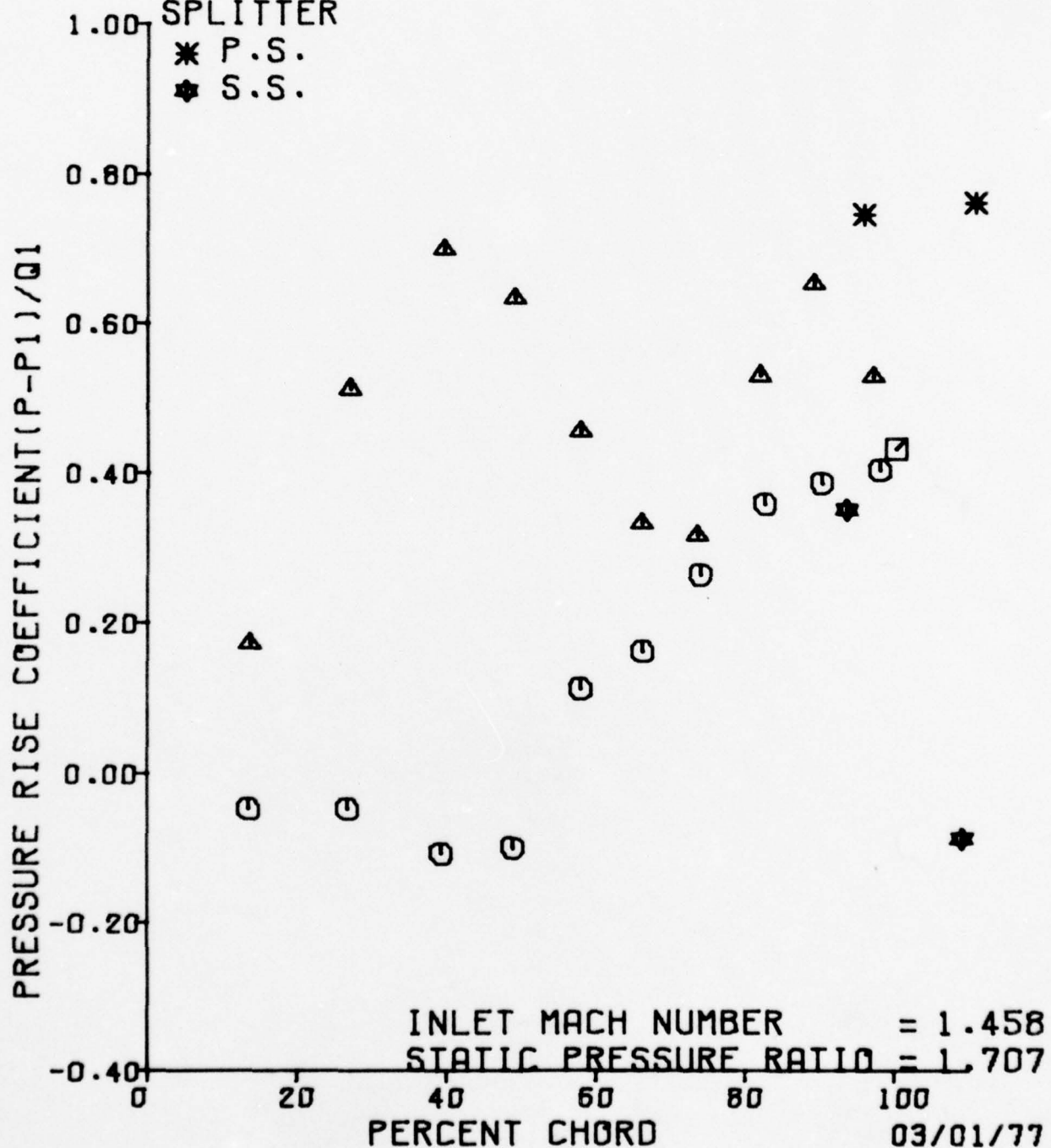
○ S.S.

□ T.E.

SPLITTER

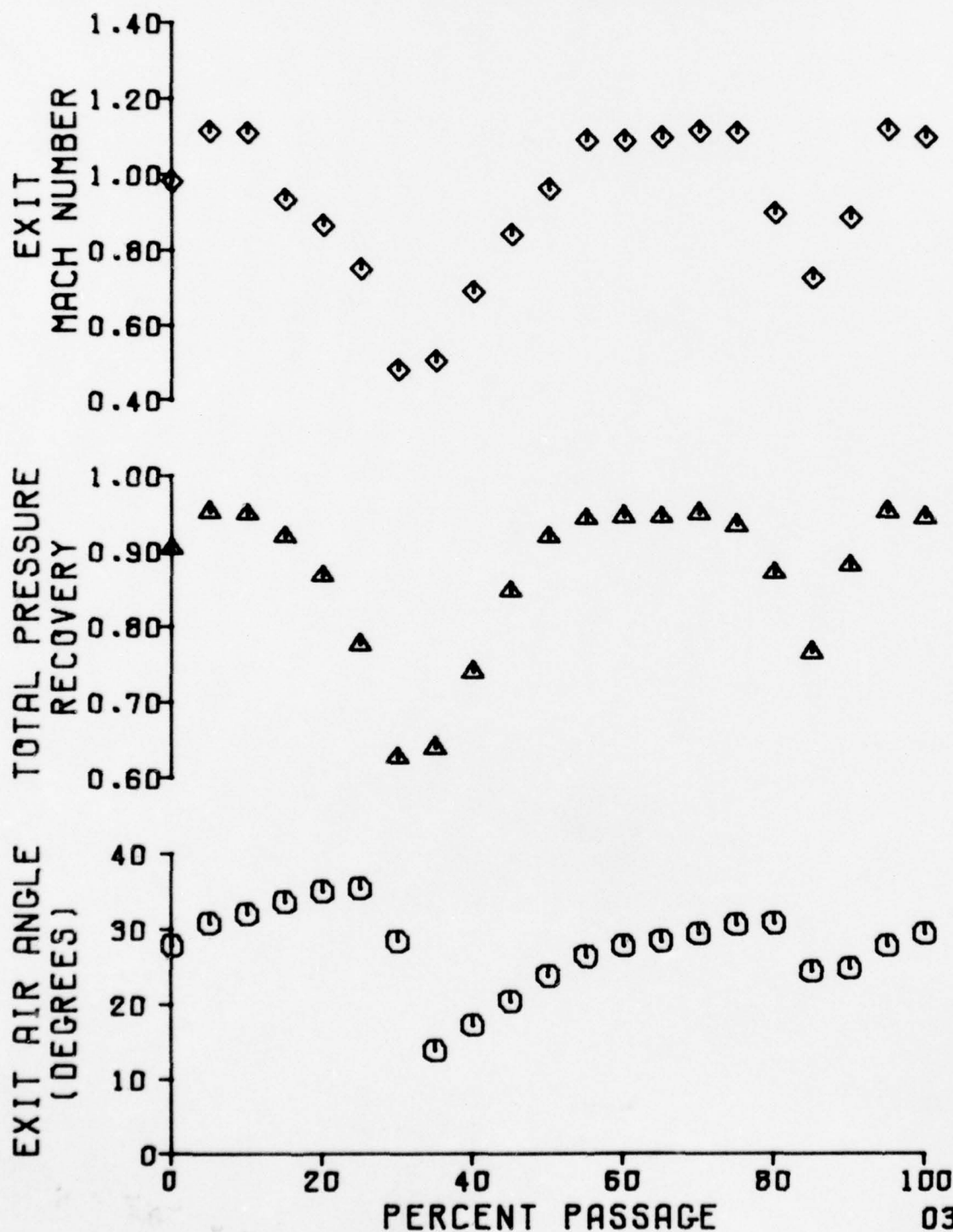
* P.S.

◆ S.S.

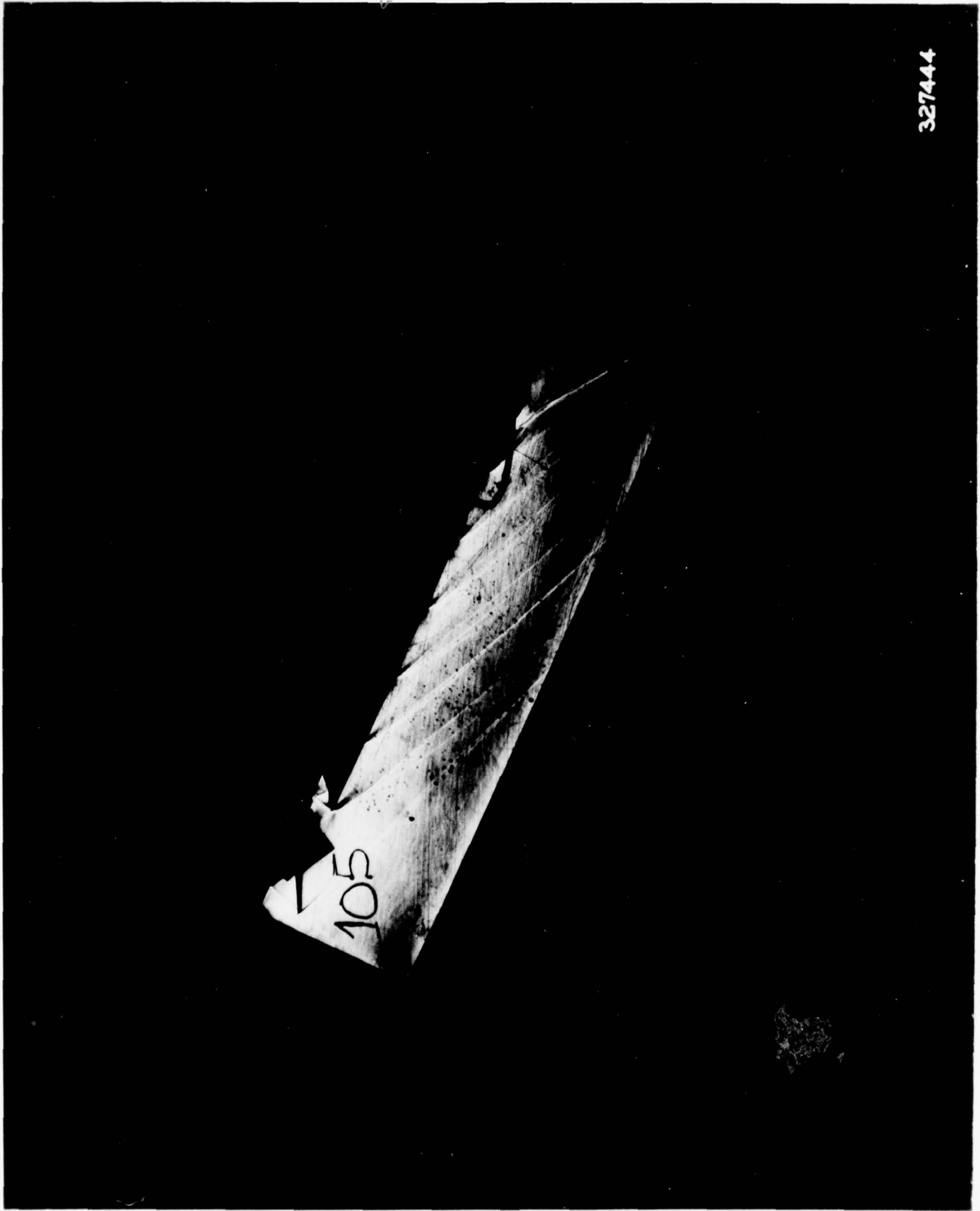


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.707



03/01/77



327444

CASCADE INLET SCHLIEREN - $MN)1 = 1.46$, $P)2/P)1 = 1.707$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.1A - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.458	1.750	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.874	1.503	58.040	24.387	560.045

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.236	43.181	1.458	1.000	1.063

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.864	19.851	19.841	19.820
11	18.443	8.582	7.784	1.730
13	11.132	8.098	10.219	5.321
15	11.577	8.585	11.743	4.812
17	11.489	14.415	11.136	5.720
19	11.418	10.762	9.620	6.598
21	19.743	9.272	8.589	7.347
23	9.551	14.416	8.537	8.201
25	9.856	9.283	10.660	8.975
27	10.025	11.534	11.451	9.217
29	9.970	10.199	10.420	9.394
31	9.806	14.427	9.832	19.846
33	9.990	9.046	9.824	2.062
35	9.702	10.827	9.817	2.614
37	9.618	9.955	9.814	1.612
39	9.952	14.409	9.479	1.581
41	10.344	10.722	9.472	1.834
43	19.820	14.419	12.146	8.737
45	4.991	19.813	12.329	5.084
47	19.828	19.839	19.855	5.081

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	43%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.204	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

MMO	PTO	TTO	MO	BETAO
1.500	19.812	560.045	8.975	65.613

CASCADE INLET CONDITIONS

MMI	PTI	TTI	BETAII	PII	MOI	QII
1.458	19.811	560.045	66.850	5.734	.241	8.531
ISS	IML	MMX,1	MMY,1	TI/TII	PT/PII	NR/10**6
1.371	3.402	.573	1.340	1.425	3.455	1.432

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.551	33	9.999
25	9.856	35	9.702
27	10.025	37	9.618
29	9.970	39	9.952
31	9.806	41	10.344

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
9.842	.165	9.923	.255	1.052	1.716

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	9.832
		33	9.824
		35	9.817
		37	9.814
		39	9.479
		41	9.472

MEAN TRAILING EDGE PRESSURE (PSIA) 9.706 RMS DEVIATION .163

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.062 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.614 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.612 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.581 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	545.907 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.834 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.104 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.443 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.107

62531

385

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.784	5.321	.240	-.048	.393	.269	13.59	13.45
13	10.219	5.321	.526	-.048	.816	.269	26.98	26.63
15	11.743	4.812	.704	-.108	.593	.243	39.50	39.24
17	11.136	5.720	.633	-.002	.562	.289	49.07	48.78
19	9.620	6.598	.456	.101	.486	.333	57.88	57.75
21	8.589	7.347	.335	.189	.434	.371	66.00	66.09
23	8.537	8.201	.329	.289	.431	.414	73.41	73.77
25	10.560	8.975	.577	.380	.536	.453	81.70	82.41
27	11.451	9.217	.670	.408	.578	.465	89.05	89.97
29	10.420	9.394	.549	.429	.526	.474	96.93	97.73
0	9.646	9.646	.459	.459	.487	.487	100.00	100.00

FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC(LF)	CP1LE
.342	-.283	.193	-34.261	-.020	.342	.133	38.864

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.146	8.737	.752	.352	.613	.441	95.57	93.37
45	12.329		.773		.622		110.63	
47		5.081		-.076		.257		109.00

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A IT)1
.00	6.284 7.020 18.857	1.114 37.296 11.053	.969 .000 11.635	.549 .925 11.299	18.886 1156.599 11.478	8.693 19.886 -2.396	.953 19.829 19.857	29.554 19.857 560.734
5.00	6.363 8.175 18.856	1.088 38.141 11.266	.935 .029 11.565	.556 .940 11.465	18.871 1134.889 11.536	8.970 19.835 -1.251	.953 19.805 19.819	30.709 19.820 560.390
6.90	6.442 9.372 18.811	1.053 34.944 11.380	.894 .028 11.393	.557 1.197 11.477	18.614 1105.087 11.492	9.234 19.839 -1.054	.940 19.812 19.824	31.906 19.825 560.390
14.99	6.521 10.867 17.980	.894 33.449 11.420	.747 .027 11.140	.492 1.911 11.354	17.980 963.347 11.372	10.647 19.865 1.451	.904 19.810 19.836	33.401 19.837 560.390
19.99	6.600 11.978 16.978	.839 32.338 11.337	.691 .025 10.901	.475 2.833 11.184	16.978 911.043 11.183	10.709 19.903 2.552	.857 19.840 19.876	34.512 19.876 560.734
24.98	6.679 12.061 15.176	.715 32.255 11.192	.588 .022 10.861	.406 4.635 10.916	15.176 789.779 10.846	10.796 19.875 2.635	.768 19.826 19.850	34.595 19.851 560.390
29.98	6.758 3.240 12.418	.456 41.076 10.916	.411 .017 11.217	.108 7.393 10.634	12.418 518.802 10.574	10.765 19.842 -6.186	.627 19.809 19.824	25.774 19.825 560.734

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)AP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
4 7 4	35.04	6.838 -8.600 12.904	.507 52.925 10.659	.492 .015 11.769	.122 6.907 10.522	12.904 573.272 10.464	10.829 19.840 -18.035	.651 19.783 19.810	13.925 19.811 560.734
9 0 0	40.04	6.917 -4.946 14.855	.685 49.262 10.505	.653 .020 12.158	.207 4.956 10.530	14.855 759.641 10.485	10.853 19.849 -14.372	.750 19.791 19.819	17.588 19.820 560.734
6 5 0	45.04	6.996 -1.934 16.829	.825 46.250 10.437	.772 .025 12.313	.290 2.982 10.789	16.829 897.963 10.840	10.765 19.834 -11.360	.849 19.791 19.812	20.600 19.813 562.734
1 7 0	50.03	7.075 1.071 18.146	.915 43.245 10.574	.839 .028 12.235	.366 1.665 11.115	18.146 982.518 11.253	10.553 19.871 -8.355	.916 19.820 19.845	23.605 19.845 560.734
2 6 4	55.03	7.154 4.165 18.635	1.053 40.151 10.862	.941 .029 12.075	.473 1.172 11.267	18.639 1105.087 11.442	9.246 19.880 -5.271	.941 19.845 19.862	26.609 19.863 561.079
5 1 0	60.03	7.233 4.082 18.533	.961 39.334 11.074	.852 .029 12.020	.444 1.278 11.184	18.533 1024.148 11.426	10.241 19.654 -4.444	.935 20.047 19.850	27.516 19.851 561.079
4 5 4	65.02	7.312 4.115 18.158	.905 40.201 10.978	.810 .029 12.028	.406 1.643 11.264	18.158 974.051 11.306	10.672 20.185 -5.311	.917 20.130 20.157	26.649 20.157 561.079

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN12 TURN P)TP	MN1X,2 M12 P)BP	MN1Y,2 EP11,2 P)NP	PT12 V12 P)SP	P12 PT10 RETA)P	PT12/PT11 PT10 PT11	RETA12 PT10,4 TT11
70.02	7.391 5.561 18.303	.928 38.755 11.068	.818 .029 11.857	.437 1.508 11.252	18.303 994.090 11.306	10.497 20.014 -3.875	.924 19.975 19.994	28.095 19.995 561.079
75.02	7.470 8.572 18.719	1.112 35.744 11.119	.952 .028 11.325	.574 1.265 11.177	18.746 1154.999 11.428	8.650 20.011 -.854	.946 19.563 19.786	31.106 19.787 561.079
80.01	7.549 8.837 17.011	.860 35.479 11.091	.734 .027 11.194	.448 2.800 10.757	17.011 931.058 11.044	10.497 19.738 -.589	.850 19.796 19.766	31.371 19.767 561.079
85.01	7.628 2.855 15.430	.735 41.462 10.703	.664 .024 11.570	.315 4.381 10.639	15.430 809.787 10.923	10.777 19.995 -6.571	.779 19.793 19.893	25.389 19.894 561.424
90.01	7.707 2.883 17.678	.885 41.433 10.692	.799 .026 11.921	.380 2.133 10.979	17.678 954.191 11.194	10.627 19.994 -6.543	.892 19.881 19.892	25.417 19.893 561.079
95.00	7.786 5.601 18.808	1.103 38.715 10.921	.973 .029 11.842	.520 .981 11.409	18.830 1147.475 11.396	8.786 19.839 -3.825	.950 19.795 19.816	28.135 19.817 561.424
100.00	7.865 6.652 18.477	.928 37.664 11.128	.810 .029 11.699	.452 1.334 11.503	18.477 994.186 11.430	10.596 19.857 -2.774	.933 19.807 19.831	29.186 19.832 561.769

SUPERSONIC COMPRESSOR CASCADE
ARI STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MM12 BETA12 PT12/PT11

.905 27.577 .881

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 T112/T12 M12/M11

.802 .419 17.445 10.264 560.045 1.164 1.021

MIXED EXIT CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 T112/T12 MM12 BETA12

.728 .416 17.129 10.803 560.045 1.141 .839 29.741

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

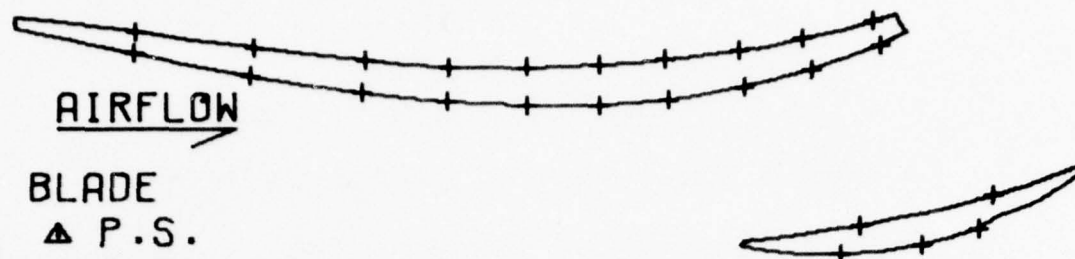
P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EQ	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.790	.881	.687	1.548	.346	1.462	1.225	.168
.039	.472	1.742	.602	1.234	.531	5.043	39.273
33.035	.442						

OVERALL PERFORMANCE

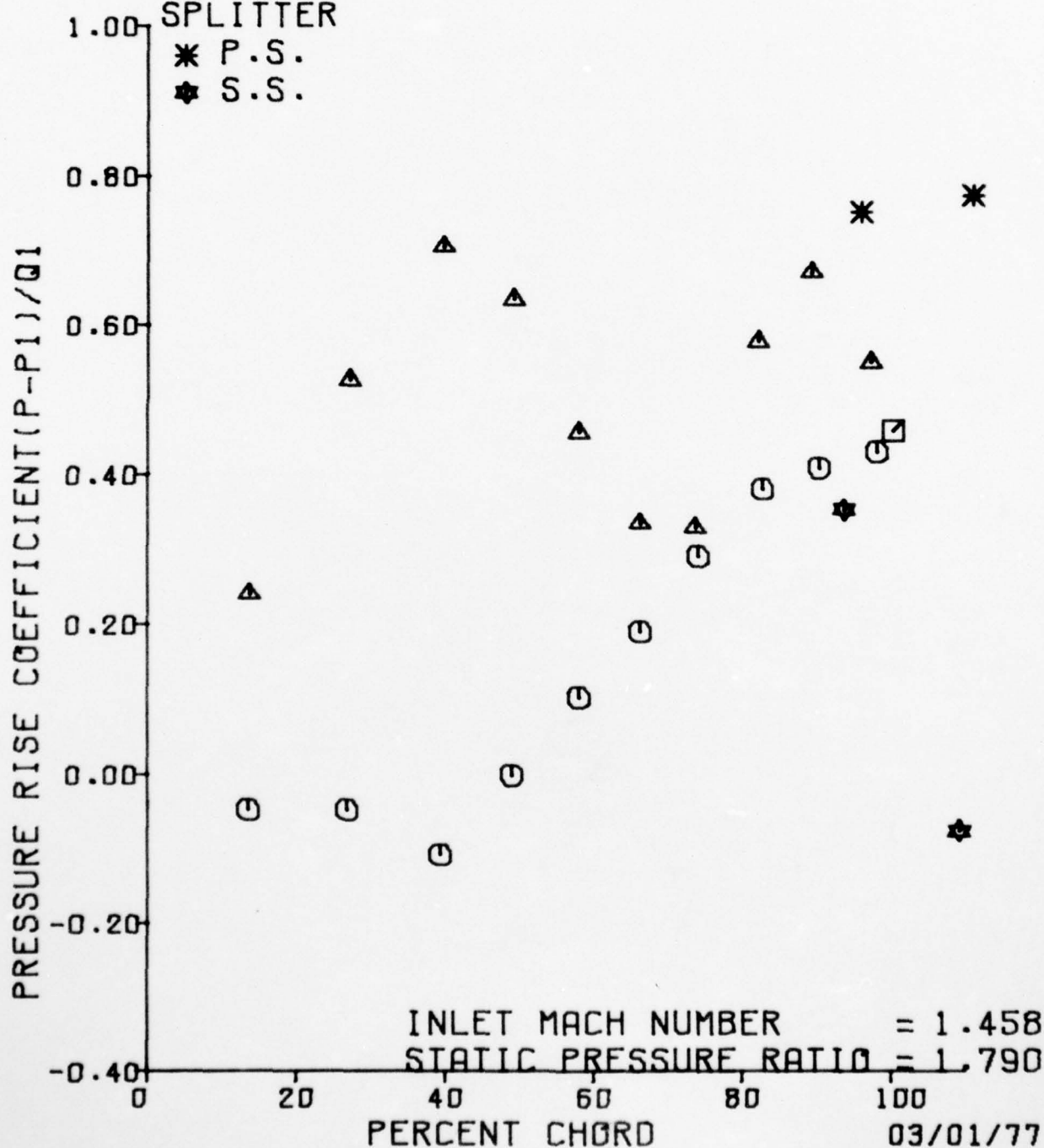
MIXED EXIT CONDITIONS

P12/P11	PT12/PT11	V12/V11	V12/V11,X	V12/V11,Y	R12/R11	T12/T11	OMEGA
TPLP	DF	DF1EQ	DV1Y	RN12	DPS/Q1	DEV	TURN
BETA1C	A12/A11						
1.884	.865	.643	1.421	.347	1.508	1.249	.190
.044	.515	1.859	.600	1.176	.594	7.207	37.109
29.853	.467						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

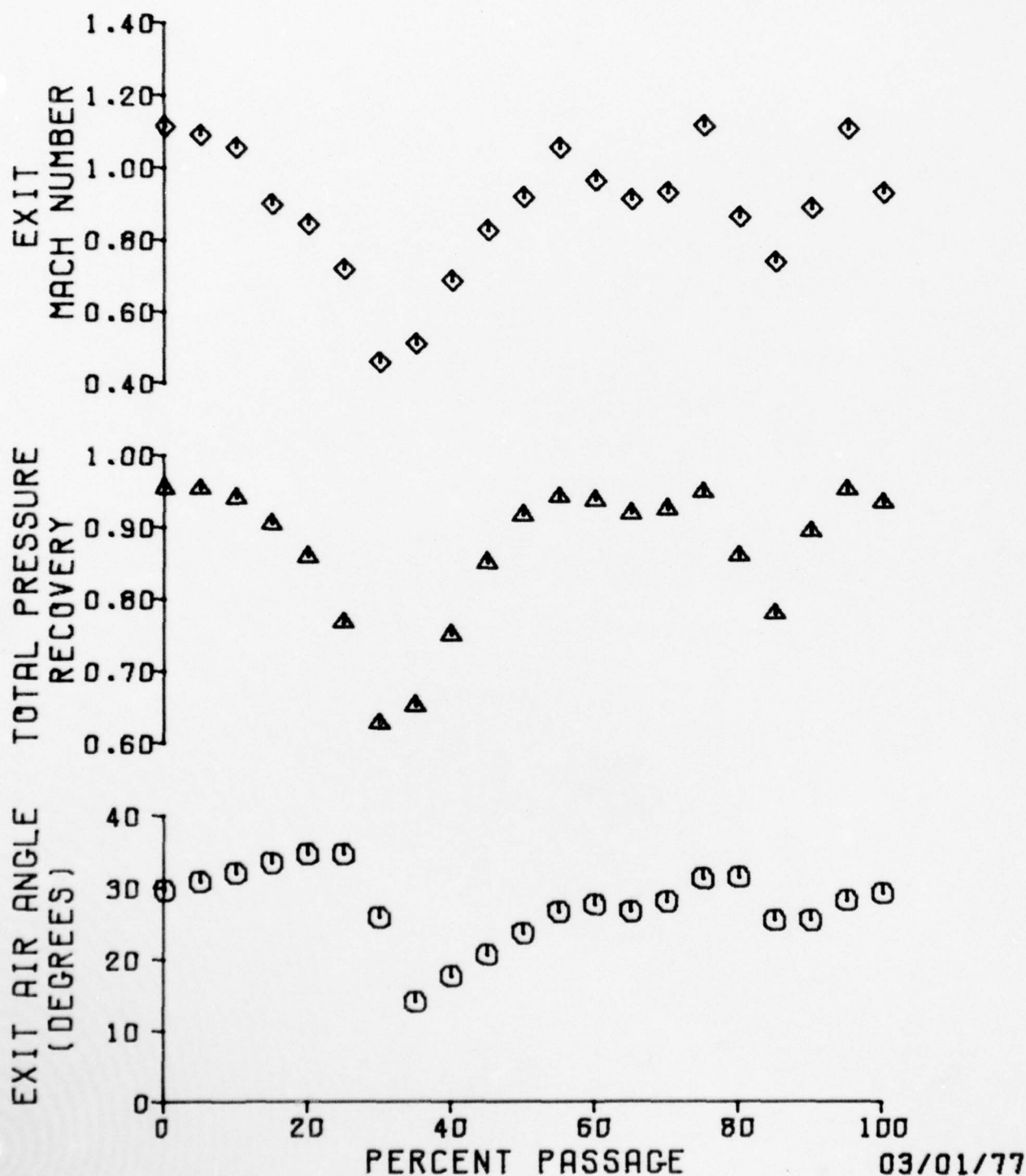


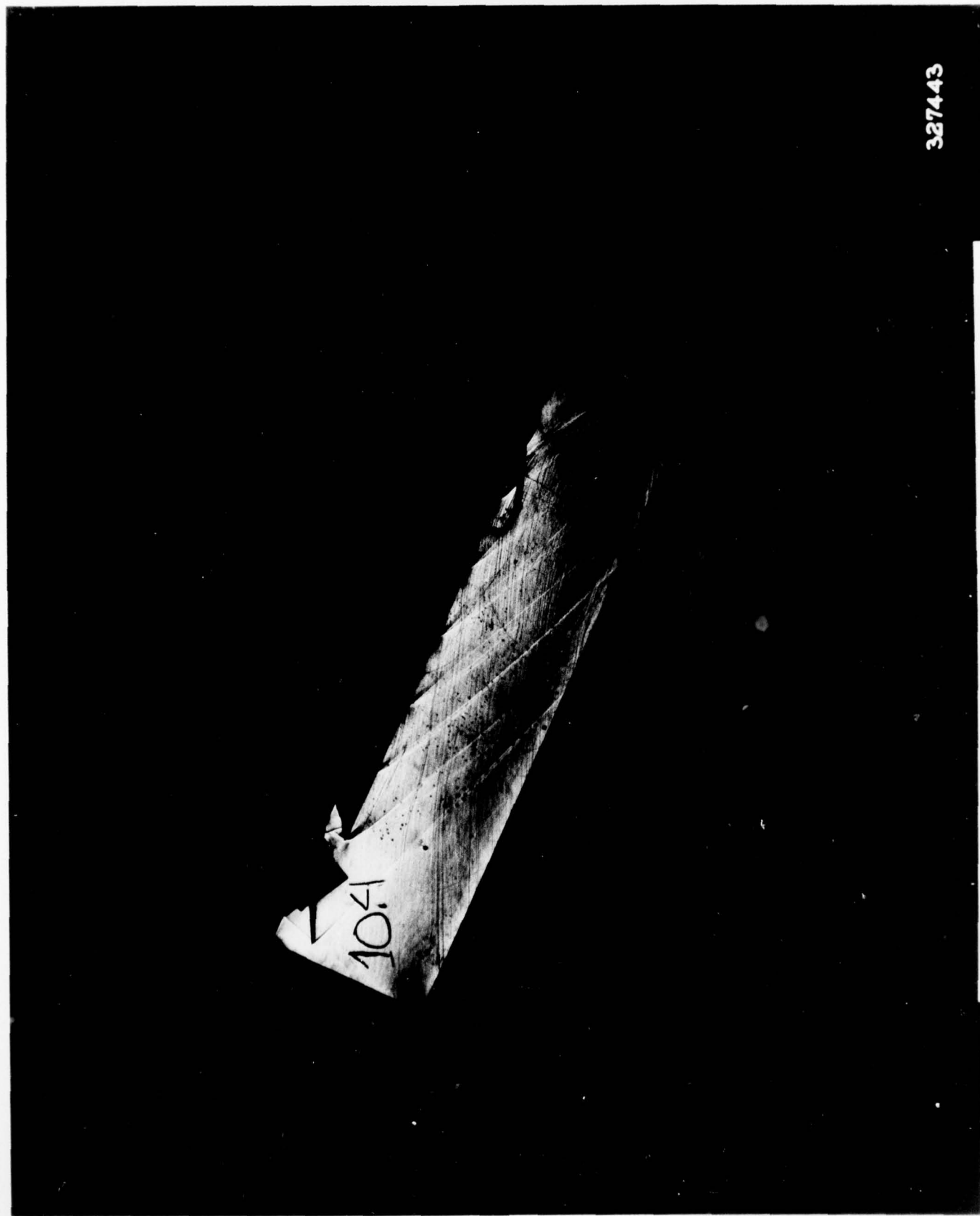
BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.790





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CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.790

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.458	1.812	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.868	1.503	58.030	24.376	563.148

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.227	43.170	1.458	1.000	1.062

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.851	19.848	19.834	19.860
11	18.376	8.601	8.303	1.737
13	11.189	8.161	10.361	5.340
15	11.799	9.040	11.785	4.824
17	11.536	14.434	11.141	6.264
19	11.483	10.867	9.627	6.856
21	19.806	9.359	8.623	7.609
23	9.781	14.435	8.752	8.448
25	10.050	9.366	10.983	9.186
27	10.206	11.713	11.622	9.449
29	10.143	10.378	10.636	9.665
31	9.902	14.448	10.081	19.861
33	10.224	9.460	10.078	2.050
35	9.924	11.002	10.072	2.634
37	9.843	10.143	10.069	1.620
39	10.137	14.431	9.764	1.583
41	10.504	10.878	9.754	1.836
43	19.848	14.438	12.186	8.755
45	4.962	19.840	12.457	5.325
47	19.815	19.839	19.838	5.324

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	43%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.204	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.824	563.148	8.956	65.624

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.458	19.824	563.148	66.850	5.735	.240	8.536
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.573	1.341	1.425	3.456	1.423

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSTA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.781	33	10.224
25	10.059	35	9.924
27	10.206	37	9.843
29	10.143	39	10.137
31	9.992	41	10.504

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.036	.147	10.126	.234	1.036	1.750

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.081
		33	10.078
		35	10.072
		37	10.069
		39	9.764
		41	9.754

MEAN TRAILING EDGE PRESSURE [PSIA] 9.970 RMS DEVIATION .149

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.050 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.534 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.520 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.583 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.245 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.836 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.099 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.431 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.105

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	8.303	5.340	.301	-.046	.419	.269	13.69	13.45
13	10.361	5.340	.542	-.046	.523	.269	26.98	26.63
15	11.785	4.824	.709	-.107	.594	.243	39.60	39.24
17	11.141	5.264	.533	.062	.562	.316	49.07	48.78
19	9.627	6.856	.456	.131	.486	.346	57.88	57.75
21	8.623	7.609	.335	.220	.435	.384	66.00	66.09
23	8.752	8.448	.353	.318	.442	.426	73.41	73.77
25	10.983	9.186	.615	.404	.554	.463	81.70	82.41
27	11.622	9.449	.890	.435	.585	.477	89.05	89.97
29	12.536	9.565	.574	.460	.537	.488	96.93	97.73
30	9.917	9.917	.490	.490	.500	.500	100.00	100.00

PC	PC1X	PC1Y	BEYAF	CL11	CL11	PC1LE	CP1LE
.344	-.285	.192	-33.982	-.022	.343	.129	37.526

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.186	8.755	.756	.354	.615	.442	85.00	85.00
45	12.457		.787		.628		100.00	100.00
47		8.324		-.046		.269		100.00

AD-A043 860

GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER

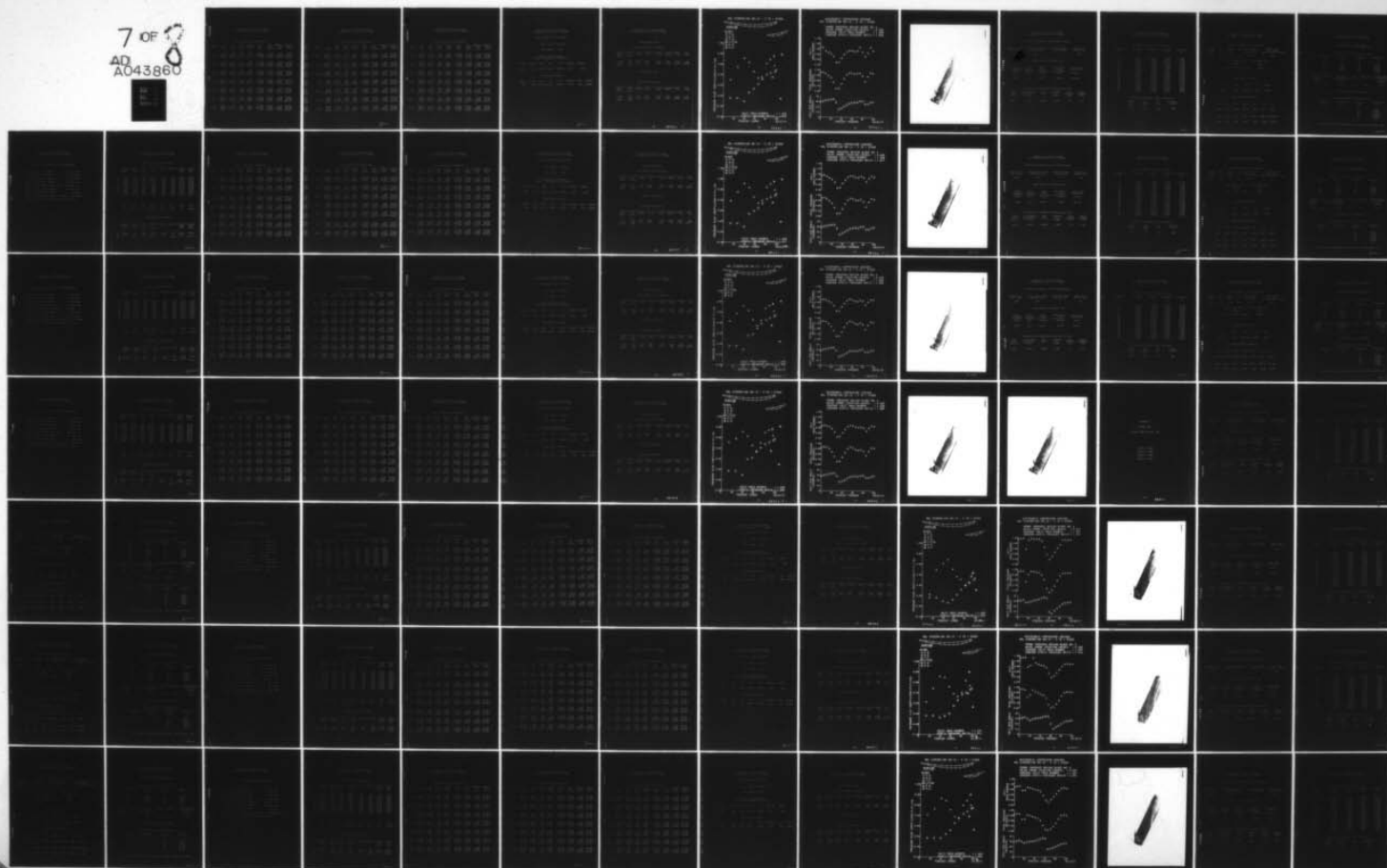
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7 OF 8
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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YR	HN)2 TURN P)TR	MN)X,2 M)2 P)RP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
.00	6.284	1.076	.938	.526	18.800	9.072	.948	29.279
	6.748	37.571	.000	1.024	1127.615	19.868	19.820	19.844
	18.790	11.144	11.781	11.406	11.587	-2.691	19.844	563.148
5.00	6.363	1.053	.906	.536	18.865	9.359	.952	30.592
	8.058	36.258	.029	.958	1108.145	19.848	19.806	19.827
	18.562	11.361	11.583	11.553	11.624	-1.378	19.826	562.803
9.99	6.442	.918	.781	.484	18.487	10.713	.933	31.786
	9.252	35.064	.028	1.336	988.211	19.854	19.816	19.835
	18.487	11.470	11.507	11.551	11.564	-.184	19.835	562.803
14.99	6.521	.863	.724	.470	17.689	10.878	.892	33.002
	10.468	33.848	.027	2.134	936.720	19.821	19.799	19.810
	17.689	11.470	11.280	11.455	11.459	1.032	19.809	563.148
19.99	6.600	.811	.672	.454	16.833	10.917	.849	34.051
	11.517	32.799	.025	2.990	887.276	19.868	19.819	19.844
	16.833	11.413	11.073	11.305	11.288	2.081	19.843	563.148
24.98	6.679	.705	.582	.398	15.249	10.946	.769	34.340
	11.806	32.510	.022	4.574	781.926	19.867	19.807	19.837
	15.249	11.306	11.012	11.062	11.004	2.370	19.837	563.148
29.98	6.758	.471	.414	.223	12.696	10.909	.640	28.288
	5.754	38.562	.017	7.127	535.771	19.841	19.814	19.828
	12.696	11.080	11.275	10.822	10.765	-3.682	19.827	563.148

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

AX2 0.4 11	PERCT	Y DEV PT1YP	MX2 TURN PT1P	MX,2 M12 P1RP	MY,2 MP11,2 P1AP	PT2 V12 P1SP	P2 PT10 PETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,4 T11
.279 .844 .148	35.24	6.838 -7.583 12.841	.482 51.899 10.832	.466 .015 11.781	.124 6.982 10.700	12.841 548.108 10.636	10.954 19.856 -17.009	.648 19.802 19.828	14.051 19.829 563.148
.502 .827 .803	40.24	6.917 -5.350 14.514	.643 49.666 10.669	.614 .019 12.187	.190 5.309 10.669	14.514 718.687 10.634	10.992 19.835 -14.786	.732 19.801 19.817	17.164 19.818 563.148
.786 .835 .803	45.24	6.996 -2.431 15.436	.783 46.747 10.592	.735 .024 12.389	.269 3.388 10.851	16.436 859.378 10.907	10.967 19.860 -11.857	.829 19.801 19.830	20.123 19.830 563.148
.002 .810 .148	50.23	7.075 .754 17.981	.885 43.562 10.698	.813 .028 12.352	.350 1.843 11.149	17.981 956.831 11.295	10.809 19.855 -8.682	.907 19.826 19.830	23.288 19.831 562.803
.051 .844 .148	55.23	7.154 3.347 18.575	.927 40.969 10.914	.834 .029 12.168	.405 1.249 11.351	18.575 995.870 11.536	10.665 19.860 -6.079	.937 19.825 19.842	25.881 19.842 562.803
.340 .837 .148	60.23	7.233 4.672 18.516	.927 39.444 11.094	.823 .029 12.033	.427 1.307 11.339	18.516 995.824 11.558	10.632 19.846 -4.564	.934 19.792 19.818	27.406 19.819 563.148
.288 .828 .148	65.22	7.312 5.281 18.215	.895 39.035 11.149	.792 .029 11.964	.418 1.609 11.264	18.215 966.814 11.555	10.825 19.863 -4.155	.919 19.810 19.836	27.815 19.837 563.148

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.391 5.813 18.365	.915 38.503 11.161	.805 .028 11.892	.435 1.458 11.274	18.365 985.236 11.535	10.680 19.840 -3.623	.926 19.806 19.823	28.347 19.823 562.803
75.02	7.470 7.646 18.566	1.053 36.670 11.180	.910 .028 11.590	.529 1.255 11.238	18.569 1108.145 11.463	9.212 19.874 -1.780	.937 19.829 19.851	30.180 19.851 563.148
80.01	7.549 8.130 17.477	.878 36.186 11.121	.755 .027 11.362	.448 2.347 11.007	17.477 950.563 11.200	10.582 19.858 -1.306	.882 19.813 19.835	30.664 19.835 562.803
85.01	7.628 2.734 15.334	.713 41.502 10.841	.644 .024 11.685	.304 4.490 10.802	15.334 789.863 10.963	10.929 19.851 -6.692	.774 19.824 19.842	25.268 19.842 562.803
90.01	7.707 2.377 17.259	.843 41.939 10.782	.764 .025 12.008	.355 2.564 11.091	17.259 917.285 11.262	10.843 19.875 -7.049	.871 19.815 19.844	24.911 19.845 563.148
95.00	7.786 5.322 18.705	1.053 38.994 10.970	.931 .028 11.923	.492 1.115 11.427	18.708 1108.145 11.470	9.281 19.866 -4.114	.944 19.829 19.847	27.856 19.848 563.148
100.00	7.865 6.413 18.414	.915 37.903 11.190	.801 .029 11.802	.443 1.410 11.536	18.414 985.236 11.499	10.708 19.864 -3.023	.929 19.826 19.844	28.947 19.845 563.148

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.867 27.493 .876

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.769	.488	17.373	10.644	563.148	1.150	.993

MIXED EXIT CONDITIONS

MN1X,2	MN1Y,2	PT12	P12	TT12	TT12/T12	MN12	BETA12
.729	.398	17.072	11.050	563.148	1.132	.813	29.322

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

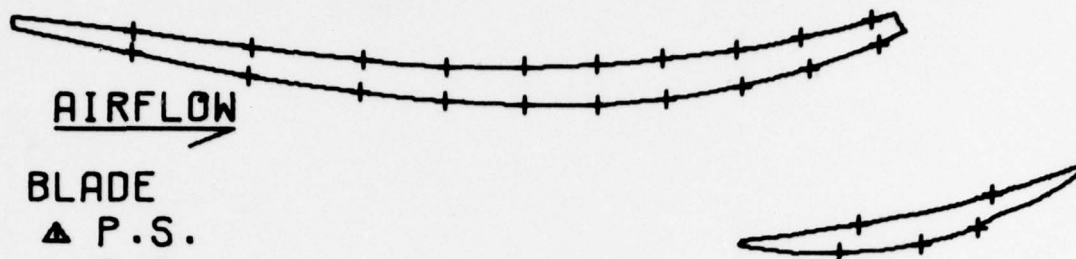
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DF)EG	DV)Y	EN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.856	.876	.662	1.493	.332	1.498	1.239	.174
.041	.500	1.810	.614	1.201	.575	4.959	39.357
31.987	.447						

OVERALL PERFORMANCE

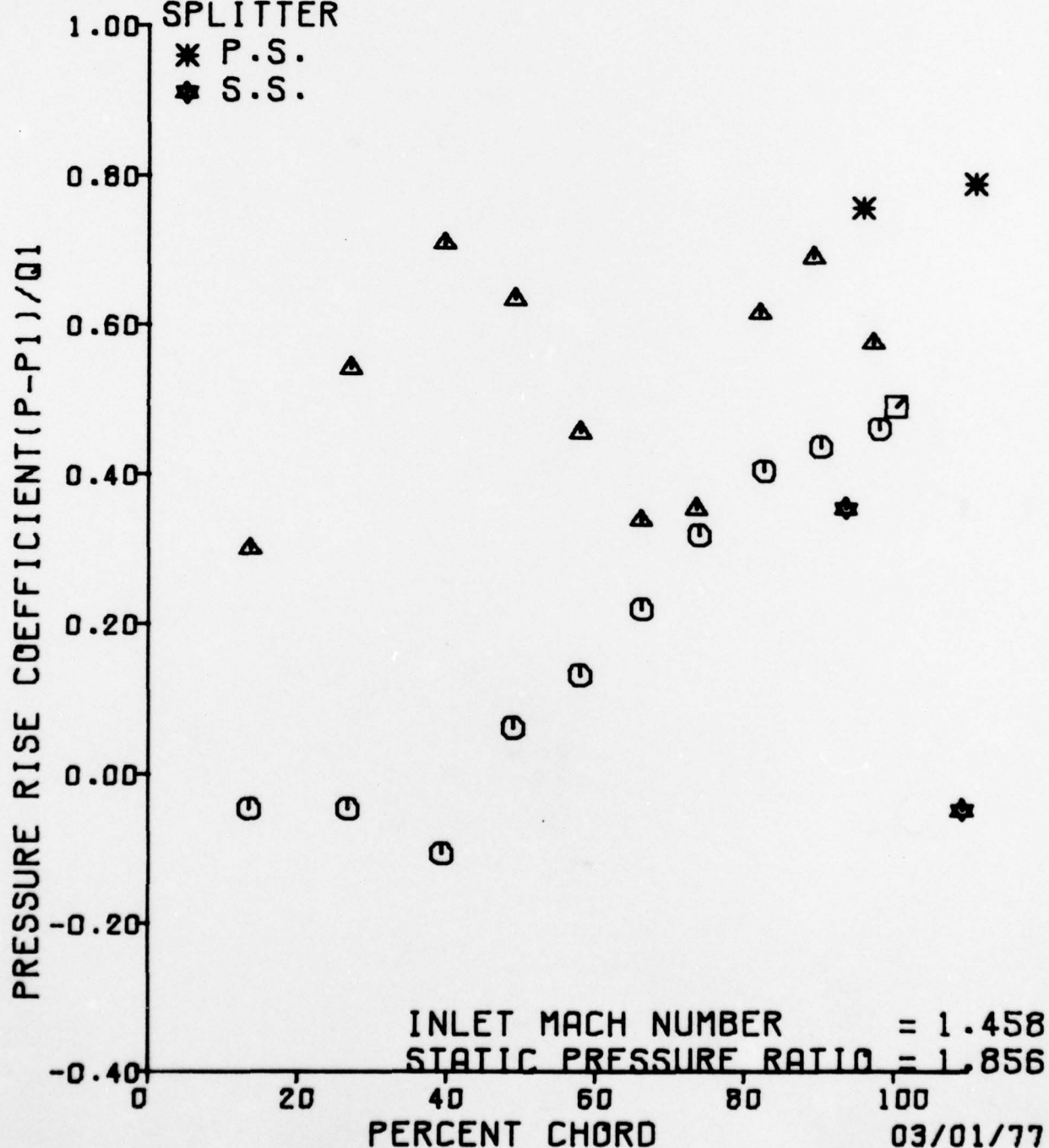
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DF)EG	DV)Y	EN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.927	.861	.626	1.388	.333	1.531	1.259	.195
.045	.535	1.913	.613	1.147	.623	6.788	37.528
28.575	.471						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

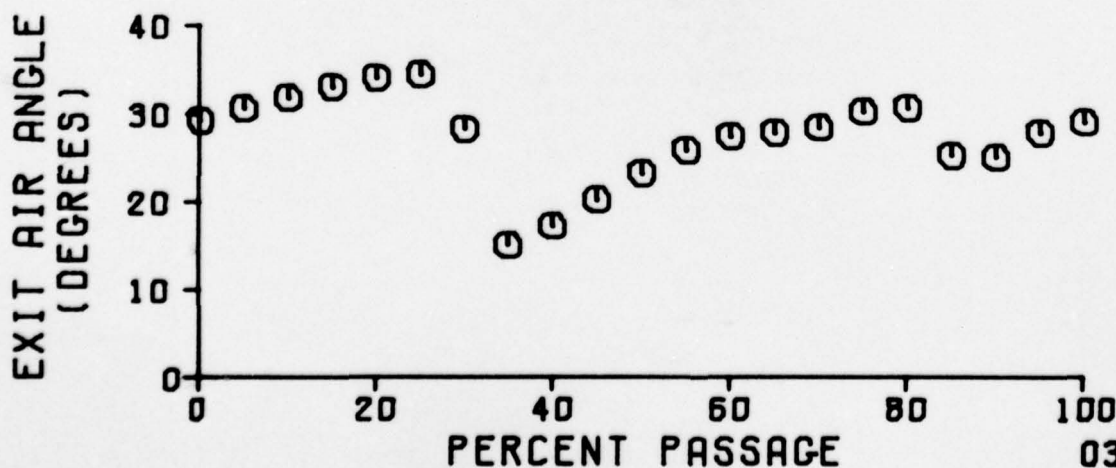
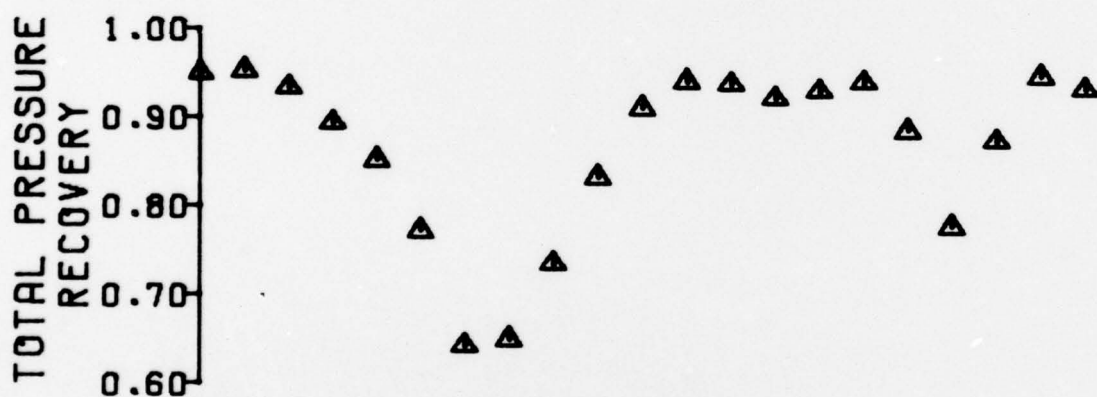
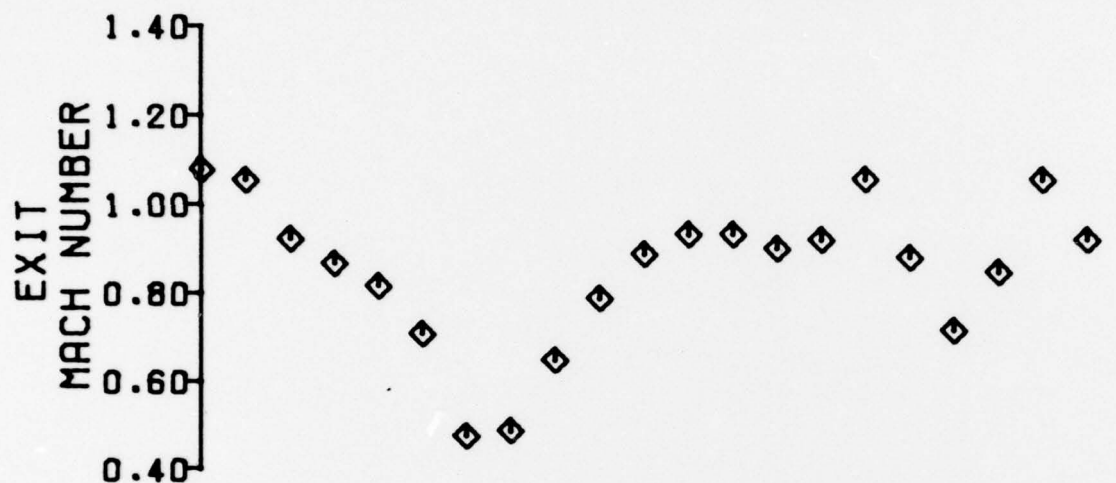


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.856



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CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.856

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.450	1.644	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.859	1.503	58.032	24.374	563.838

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.223	43.166	1.458	1.000	1.062

82531

401

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	10.878	10.886	10.872	10.868
11	10.190	6.601	9.028	1.731
13	11.267	8.436	10.419	5.361
15	11.884	9.594	11.812	4.831
17	11.582	14.450	11.144	6.896
19	11.558	10.960	9.637	7.392
21	10.817	9.442	8.656	7.837
23	9.984	14.452	9.250	8.614
25	10.218	9.437	11.216	9.339
27	10.358	11.873	11.769	9.650
29	10.281	10.541	10.827	9.905
31	10.153	14.462	10.300	10.869
33	10.380	9.879	10.291	2.043
35	10.101	11.141	10.287	2.639
37	10.039	10.304	10.285	1.615
39	10.294	14.448	10.009	1.583
41	10.652	11.023	10.003	1.818
43	10.834	14.456	12.190	8.759
45	4.960	10.868	12.543	5.687
47	10.842	10.858	10.863	5.686

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	43%

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.846	563.838	8.961	65.626

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.458	19.845	563.838	66.850	5.740	.240	8.546
1)SS	1)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.573	1.341	1.425	3.457	1.422

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

ANE)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.984	33	10.389
25	10.218	35	10.101
27	10.358	37	10.039
29	10.281	39	10.294
31	10.153	41	10.652

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)11
10.199	.127	10.295	.219	1.023	1.777

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.300
		33	10.291
		35	10.287
		37	10.285
		39	10.009
		41	10.003

MEAN TRAILING EDGE PRESSURE [PSIA] 10.196 RMS DEVIATION .134

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.043 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.639 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.615 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.583 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.072 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.818 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.087 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.404 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.098

62581

403

11
13
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17
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43
45
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.028	5.361	.385	-.044	.455	.270	13.69	13.45
13	10.419	5.361	.547	-.044	.525	.270	26.98	26.63
15	11.812	4.831	.710	-.106	.595	.243	39.60	39.24
17	11.144	6.896	.632	.135	.562	.347	49.37	48.78
19	9.637	7.392	.456	.193	.486	.372	57.88	57.75
21	8.656	7.837	.341	.245	.436	.395	66.00	66.09
23	9.050	6.614	.387	.336	.456	.434	73.41	73.77
25	11.216	9.339	.641	.421	.565	.471	81.70	82.41
27	11.769	9.650	.706	.457	.593	.486	89.05	89.97
29	10.827	9.905	.595	.487	.545	.499	96.93	97.73
30	10.147	10.147	.516	.516	.511	.511	100.00	100.00
	FC	FC)Y	FC)Y	BETA)F	CD)1	CL)1	MO)LE	CP)LE
	.345	-.287	.191	-33.705	-.024	.344	.124	35.914

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/O1 (PS)	DPS/O1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.198	8.759	.755	.353	.614	.441	95.57	93.37
45	12.543		.796		.632		110.63	
47		8.686		-.006		.287		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT(Y)	MM12 TURN P(T)	MM1Y,2 M12 P(M)	MM1Y,2 DP11,2 P(M)	PT12 V12 P(M)	P12 PT10 BETA1)P	PT12/PT11 PT10 PT11	BETA1)2 PT10,4 TT11
.20	6.284 6.223 18.653	.929 38.093 11.208	.814 .000 11.877	.447 1.162 11.493	18.683 998.547 11.655	10.701 19.892 -3.203	.941 19.834 19.862	28.757 19.863 563.838
5.00	6.363 7.794 18.844	.961 36.522 11.421	.829 .029 11.775	.485 1.002 11.628	18.844 1027.587 11.689	10.413 19.871 -1.632	.950 19.844 19.857	30.328 19.857 563.493
9.99	6.442 9.009 18.444	.906 35.217 11.543	.771 .028 11.609	.475 1.401 11.630	18.444 977.344 11.641	10.835 19.886 -.327	.929 19.803 19.844	31.633 19.845 563.838
14.99	6.521 10.150 17.615	.849 34.166 11.524	.714 .027 11.394	.458 2.230 11.540	17.615 923.563 11.532	10.998 19.886 .724	.888 19.835 19.860	32.684 19.861 563.838
19.99	6.590 10.890 16.688	.789 33.426 11.432	.658 .025 11.204	.434 3.157 11.439	16.688 865.695 11.385	11.071 19.838 1.454	.841 19.790 19.813	33.424 19.814 563.838
24.98	6.679 11.344 15.145	.685 32.972 11.360	.569 .022 11.134	.382 4.700 11.182	15.145 762.132 11.128	11.066 19.877 1.908	.763 19.826 19.851	33.878 19.851 563.838
29.98	6.758 4.395 12.795	.463 39.921 11.184	.413 .017 11.445	.210 7.050 10.956	12.795 527.809 10.902	11.047 19.877 -5.041	.645 19.818 19.847	26.929 19.848 563.838

18581

404

1

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

TA)2 0,4 T)1	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 RETA)P	PT)2/P)1 PT)0 PT)1	RETA)2 PT)0,4 T)1
.757 .863 .838	35.24	6.838 -7.649 12.997	.483 51.965 10.944	.467 .015 11.911	.124 6.849 10.816	12.997 549.300 10.787	11.081 19.877 -17.085	.655 19.821 19.848	14.885 19.849 563.838
.328 .857 .493	40.24	6.917 -4.938 14.659	.643 49.254 10.789	.613 .019 12.279	.194 5.186 10.772	14.659 719.097 10.774	11.102 19.878 -14.364	.730 19.823 19.850	17.596 19.851 563.493
.633 .845 .838	45.24	6.996 -2.221 16.507	.777 46.537 10.697	.729 .024 12.455	.270 3.339 10.953	16.507 854.236 11.037	11.076 19.875 -11.657	.832 19.816 19.845	22.313 19.845 563.838
.684 .861 .838	50.23	7.075 .767 17.971	.876 43.549 10.778	.804 .027 12.409	.346 1.874 11.246	17.971 949.269 11.422	10.904 19.864 -8.659	.906 19.846 19.854	23.301 19.855 563.493
.424 .814 .838	55.23	7.154 3.632 18.628	.927 40.684 11.014	.832 .029 12.214	.409 1.217 11.408	18.628 997.011 11.621	10.689 19.873 -5.794	.939 19.835 19.853	26.166 19.854 563.493
.878 .851 .838	60.23	7.233 5.082 18.429	.906 39.234 11.164	.803 .029 12.036	.420 1.416 11.356	18.429 977.344 11.624	10.825 19.867 -4.344	.929 19.805 19.835	27.616 19.836 563.838
.929 .848 .838	65.22	7.312 5.214 17.927	.869 39.102 11.197	.769 .028 11.986	.405 1.918 11.268	17.927 943.049 11.603	10.954 19.871 -4.222	.903 19.822 19.846	27.748 19.846 563.838

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MM2 TURN F)TP	MM)Y,2 M)2 P)RP	MM)Y,2 DP)1,2 P)MP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A T)1
70.02	7.391 5.347 17.868	.868 38.969 11.171	.768 .028 11.939	.406 1.977 11.260	17.868 942.115 11.572	10.929 19.885 -4.079	.900 19.836 19.860	27.881 19.860 563.838
75.22	7.470 7.003 18.236	.906 37.313 11.184	.788 .028 11.668	.447 1.609 11.253	18.236 977.344 11.557	10.712 19.880 -2.433	.919 19.822 19.851	29.537 19.851 563.838
80.01	7.549 7.830 17.362	.860 36.486 11.177	.742 .027 11.463	.435 2.483 11.051	17.362 934.381 11.296	10.712 19.886 -1.596	.875 19.828 19.856	32.364 19.857 563.838
85.01	7.628 2.547 15.391	.706 41.769 10.935	.639 .024 11.796	.299 4.454 10.904	15.391 783.561 11.060	11.037 19.875 -6.889	.776 19.816 19.845	25.081 19.845 563.838
90.01	7.707 2.487 17.227	.830 41.829 10.873	.752 .025 12.060	.351 2.619 11.173	17.227 905.764 11.330	10.964 19.866 -6.949	.868 19.812 19.838	25.021 19.839 563.838
95.00	7.786 4.996 18.527	.925 39.320 11.078	.820 .028 11.989	.428 1.319 11.472	18.527 995.090 11.545	10.655 19.863 -4.430	.934 19.815 19.838	27.530 19.839 563.838
100.00	7.868 6.259 18.226	.885 38.027 11.263	.775 .028 11.871	.426 1.619 11.579	18.226 957.417 11.561	10.956 19.870 -3.137	.918 19.836 19.852	28.823 19.853 563.838

62581

405

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN12 BETA12 PT12/PT11

.829 27.281 .871

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 M12/M11

.737 .380 17.277 11.005 563.838 1.138 .985

MIXED EXIT CONDITIONS

MN1X,2 MN1Y,2 PT12 P12 TT12 TT12/TT2 MN12 BETA12

.694 .379 17.002 11.253 563.838 1.125 .791 28.667

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

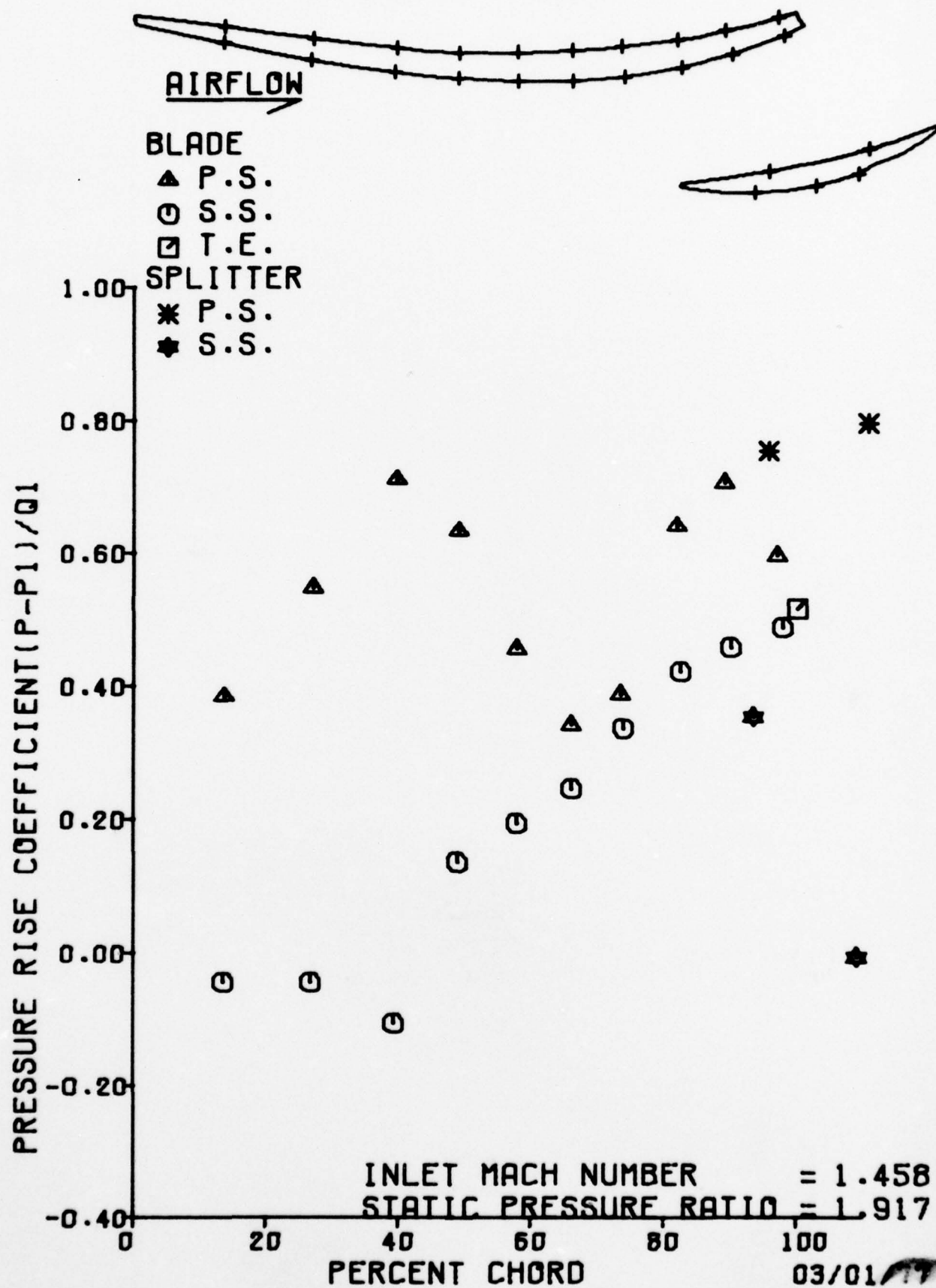
P02/P01	PT02/PT01	V02/V01	V02/V01,X	V02/V01,Y	R02/R01	T02/T01	OMEGA
TPLP	DE	DELEG	DV0Y	FN02	DFS/Q1	DEV	TURN
BETA0C	A02/A01						
1.917	.871	.637	1.439	.317	1.530	1.253	.182
.043	.529	1.884	.628	1.170	.616	4.747	39.569
30.250	.454						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

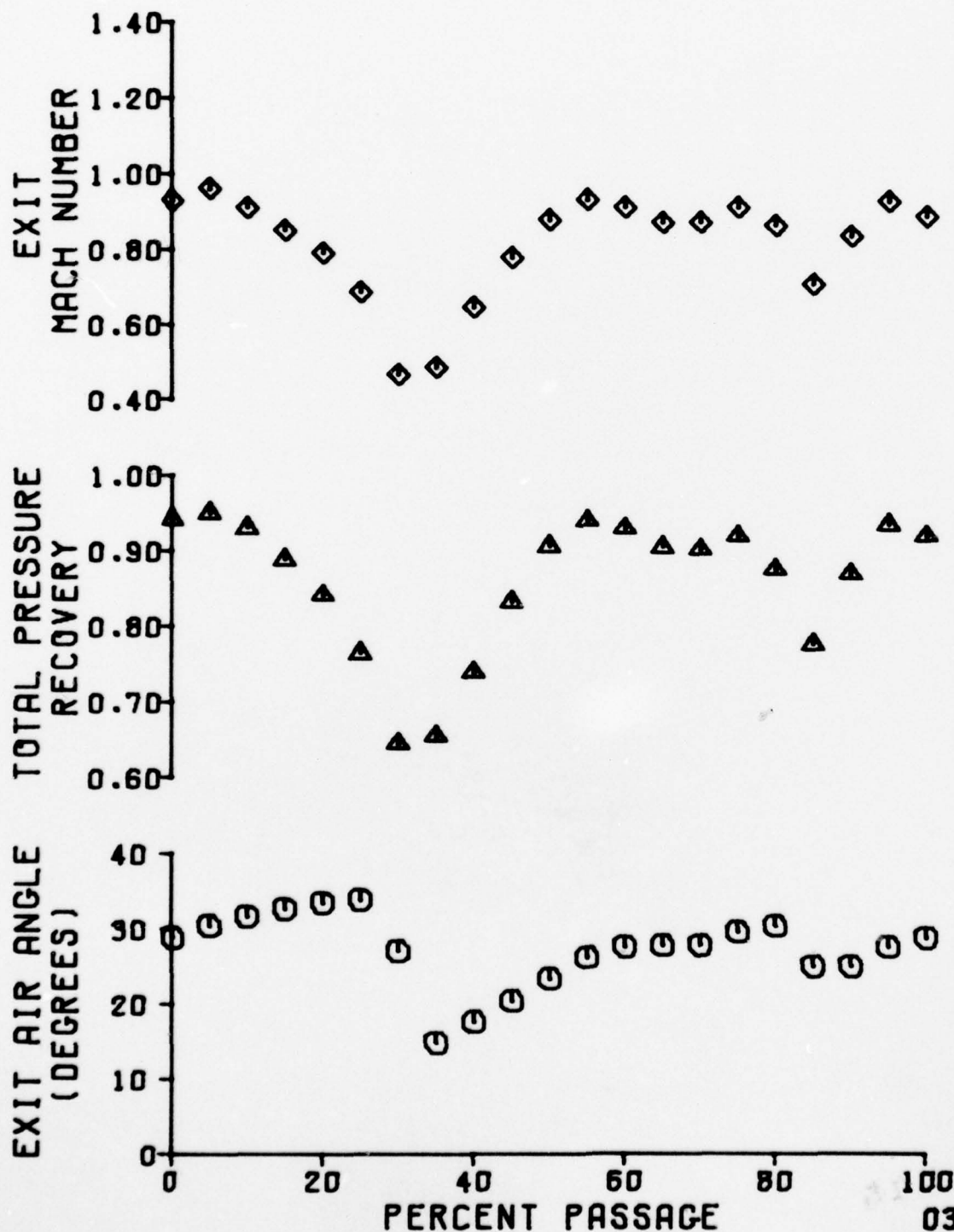
P02/P01	PT02/PT01	V02/V01	V02/V01,X	V02/V01,Y	R02/R01	T02/T01	OMEGA
TPLP	DE	DELEG	DV0Y	FN02	DFS/Q1	DEV	TURN
BETA0C	A02/A01						
1.950	.857	.610	1.363	.319	1.548	1.267	.202
.047	.554	1.964	.627	1.125	.645	6.133	38.183
27.064	.474						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

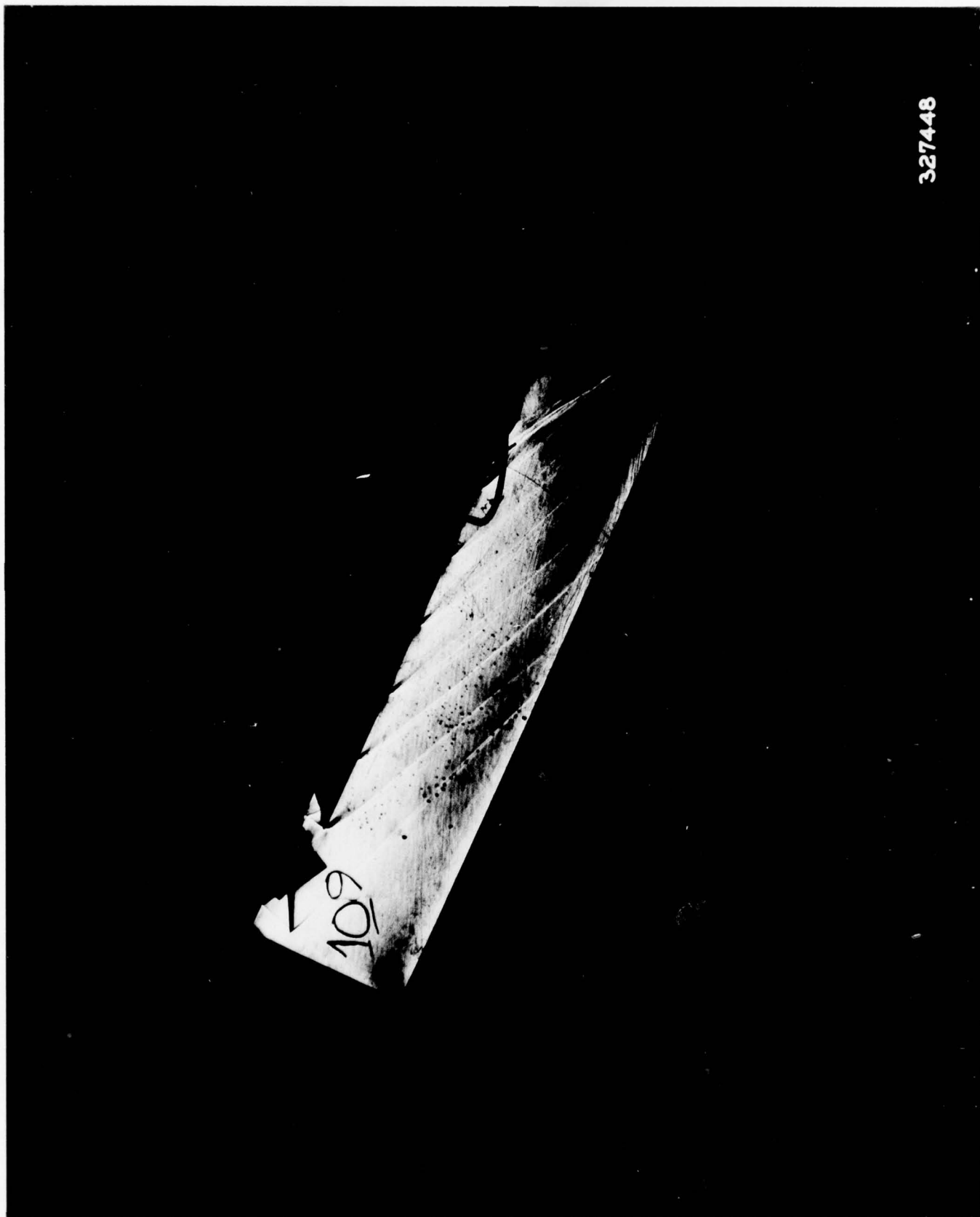


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.917



03/01/77



327448

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.917

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.458	1.815	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.503	58.030	24.376	563.148

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.224	43.166	1.458	1.000	1.062

62581

410

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.895	19.873	19.876	19.891
11	18.126	6.612	9.444	1.730
13	11.350	8.736	10.632	5.407
15	12.006	9.768	11.843	4.824
17	11.672	14.443	11.125	7.062
19	11.676	11.882	9.626	7.293
21	19.827	9.742	8.682	8.233
23	10.204	14.444	9.520	8.992
25	10.438	9.736	11.478	9.604
27	10.544	12.046	11.951	9.910
29	10.462	10.724	11.038	10.184
31	10.366	14.454	10.544	19.874
33	10.580	10.306	10.540	2.034
35	10.320	11.319	10.528	2.646
37	10.261	10.505	10.528	1.623
39	10.497	14.438	10.288	1.586
41	10.830	11.194	10.281	1.819
43	19.837	14.445	12.231	8.757
45	4.984	19.856	12.660	6.134
47	19.851	19.859	19.884	6.134

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	43%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.204	1.581	.936	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

PN)0	PT)0	TT)0	M)0	BETA)0
1.500	19.851	563.148	8.969	65.624

CASCADE INLET CONDITIONS

PN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.458	19.851	563.148	66.850	5.742	.241	8.548
I)SS	I)ML	KN)X,1	KN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.573	1.341	1.425	3.457	1.425

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.204	33	10.520
25	10.438	35	10.320
27	10.544	37	10.261
29	10.462	39	10.497
31	10.366	41	10.830

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
10.403	.114	10.499	.203	1.007	1.812

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.544
		33	10.540
		35	10.528
		37	10.528
		39	10.268
		41	10.281

MEAN TRAILING EDGE PRESSURE [PSIA] 10.451 RMS DEVIATION .118

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.034 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.646 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.623 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.586 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.390 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.819 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.089 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.408 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.099

62581

412

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.444	5.407	.433	-.039	.476	.272	13.69	13.45
13	10.632	5.407	.572	-.039	.536	.272	26.98	26.63
15	11.843	4.824	.714	-.107	.597	.243	39.50	39.24
17	11.125	7.062	.630	.154	.562	.356	49.07	48.78
19	9.626	7.293	.454	.181	.485	.367	57.88	57.75
21	8.682	8.233	.344	.291	.437	.415	66.00	66.09
23	9.520	8.992	.442	.380	.480	.453	73.41	73.77
25	11.478	9.604	.671	.452	.578	.484	81.70	82.41
27	11.951	9.919	.726	.489	.602	.500	89.05	89.97
29	11.038	10.184	.619	.520	.556	.513	96.93	97.73
3	10.408	10.408	.546	.546	.524	.524	100.00	100.00
	FC	FC(X)	FC(Y)	BETA(F)	CD11	CL11	MC1LE	CP1LE
	.350	-.292	.193	-33.400	-.026	.349	.123	34.970

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT11	SS/PT11	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.231	8.757	.759	.353	.616	.441	95.57	93.37
45	12.660		.809		.638		110.63	
47		6.134		.046		.309		109.00

2

18581

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YR	MAJ2 TURN PT1P	MAJY,2 M12 P1RP	MAJY,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A T111
.00	6.284 6.040 18.514	.895 38.276 11.316	.786 .000 11.994	.428 1.336 11.606	18.514 966.814 11.766	11.003 19.876 -3.396	.933 19.822 19.848	28.574 19.849 563.148
5.00	6.363 7.455 18.704	.906 36.861 11.504	.785 .028 11.908	.453 1.146 11.738	18.704 976.746 11.806	10.987 19.861 -1.981	.942 19.814 19.837	29.989 19.838 563.148
9.99	6.442 8.717 18.403	.882 35.899 11.637	.754 .028 11.777	.458 1.447 11.774	18.403 954.647 11.746	11.091 19.865 -.719	.927 19.812 19.838	31.251 19.839 563.493
14.99	6.521 9.806 17.634	.832 34.510 11.626	.703 .027 11.560	.445 2.217 11.689	17.634 907.378 11.659	11.197 19.855 .380	.888 19.799 19.826	32.340 19.827 563.493
19.99	6.600 10.799 16.638	.769 33.517 11.559	.642 .025 11.353	.422 3.213 11.580	16.638 845.724 11.529	11.253 19.864 1.363	.838 19.809 19.836	33.333 19.837 563.493
24.98	6.679 11.090 15.050	.658 33.226 11.484	.548 .022 11.301	.364 4.801 11.384	15.050 734.378 11.323	11.253 19.869 1.654	.758 19.823 19.846	33.624 19.846 563.148
29.98	6.758 5.839 12.910	.455 38.477 11.354	.401 .017 11.535	.216 6.940 11.144	12.910 518.874 11.073	11.200 19.883 -3.587	.650 19.823 19.852	28.373 19.853 563.148

413

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT(Y)P	MN12 TURN P(T)P	MN1Y,2 M12 P1RP	MN1Y,2 DP11,2 P1NP	PT12 V12 P1SP	P12 PT10 BETA1)P	PT12/PT11 PT10 PT11	BETA12 PT10,A TT11
74 49 48	35.24	6.838 -6.319 12.997	.462 50.635 11.139	.443 .015 11.957	.129 6.853 11.016	12.997 526.035 10.976	11.230 19.855 -15.755	.655 19.813 19.833	16.215 19.834 563.148
89 38 48	40.04	6.917 -4.390 14.552	.615 48.706 12.994	.585 .018 12.330	.192 5.299 10.975	14.552 690.205 10.988	11.270 19.870 -13.826	.733 19.811 19.840	18.144 19.841 563.148
51 39 93	45.04	6.996 -2.117 16.286	.745 46.433 10.900	.690 .023 12.532	.260 3.564 11.106	16.286 822.622 11.193	11.262 19.869 -11.553	.820 19.827 19.848	20.417 19.848 563.148
48 27 93	50.23	7.075 .808 17.841	.852 43.418 10.957	.782 .027 12.506	.339 2.010 11.352	17.841 925.955 11.520	11.103 19.877 -8.538	.899 19.821 19.848	23.432 19.849 563.148
33 37 93	55.23	7.154 3.771 18.558	.906 40.545 11.146	.812 .029 12.290	.401 1.293 11.506	18.558 976.746 11.732	10.901 19.880 -5.665	.935 19.825 19.852	26.305 19.853 563.493
24 45 48	60.23	7.233 5.114 18.243	.880 39.202 11.283	.779 .029 12.114	.408 1.608 11.439	18.243 952.125 11.728	11.026 19.855 -4.312	.919 19.798 19.826	27.648 19.827 563.493
73 53 48	65.22	7.312 4.957 17.600	.835 39.359 11.260	.741 .028 12.046	.385 2.251 11.346	17.600 909.832 11.678	11.146 19.863 -4.479	.887 19.820 19.841	27.491 19.842 563.148

18589

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.12 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEF PT)YP	MN)2 TURN P)TP	MN)Y,2 M)2 P)RP	MN)Y,2 EP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	7.301 4.834 17.436	.820 39.482 11.245	.729 .027 12.031	.377 2.414 11.331	17.436 905.915 11.639	11.207 19.836 -4.602	.878 19.800 19.818	27.368 19.818 563.148
75.02	7.470 6.461 17.810	.863 37.855 11.237	.755 .027 11.756	.418 2.041 11.337	17.810 936.720 11.661	10.952 19.850 -2.975	.897 19.795 19.822	28.995 19.822 563.148
80.01	7.549 7.420 17.241	.833 36.896 11.250	.721 .026 11.596	.416 2.610 11.182	17.241 907.628 11.455	10.945 19.852 -2.016	.869 19.813 19.832	29.954 19.832 563.148
85.01	7.628 2.075 15.360	.889 41.341 11.118	.622 .024 11.896	.297 4.470 11.053	15.390 766.190 11.215	11.194 19.857 -6.451	.775 19.816 19.836	25.509 19.836 563.148
90.01	7.707 2.609 17.025	.800 41.707 11.034	.724 .024 12.141	.342 2.826 11.299	17.025 876.253 11.426	11.168 19.848 -6.827	.858 19.801 19.820	25.143 19.821 563.148
95.00	7.788 4.616 18.291	.885 39.500 11.196	.786 .027 12.094	.406 1.559 11.580	18.291 956.831 11.632	10.996 19.850 -4.620	.921 19.797 19.823	27.350 19.824 563.493
100.00	7.865 6.102 18.074	.863 38.214 11.370	.758 .028 11.992	.414 1.777 11.670	18.074 936.720 11.677	11.115 19.866 -3.324	.911 19.812 19.839	28.636 19.839 563.148

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MM12 BETA12 PT12/PT11

.800 27.279 .853

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 TT12/TT12 M12/M11

.711 .367 17.131 11.233 563.148 1.128 .967

MIXED EXIT CONDITIONS

MM1X,2 MM1Y,2 PT12 P12 T112 TT12/TT12 MM12 BETA12

.672 .366 16.875 11.449 563.148 1.117 .766 28.568

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DE)EQ	OV)Y	FN)2	DPS/Q1	DEV	TURN
RETA)C	A)2/A)1						
1.956	.863	.617	1.395	.308	1.548	1.263	.193
.045	.551	1.946	.637	1.142	.642	4.745	39.571
28.277	.463						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DE	DE)EQ	OV)Y	FN)2	DPS/Q1	DEV	TURN
RETA)C	A)2/A)1						
1.904	.850	.593	1.325	.308	1.563	1.276	.211
.040	.574	2.024	.636	1.100	.668	6.034	38.282
24.791	.483						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

△ P.S.

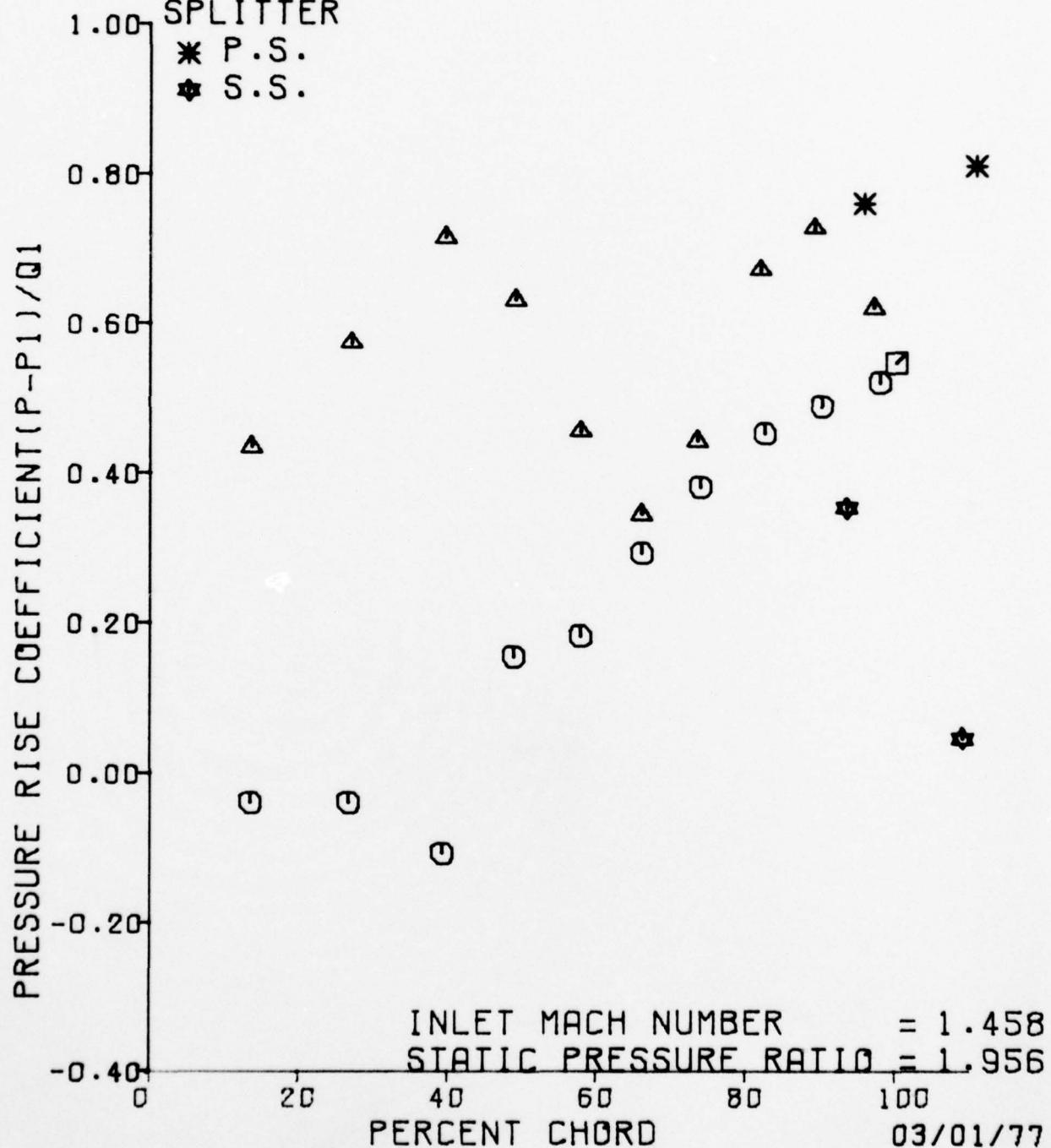
○ S.S.

□ T.E.

SPLITTER

* P.S.

☆ S.S.



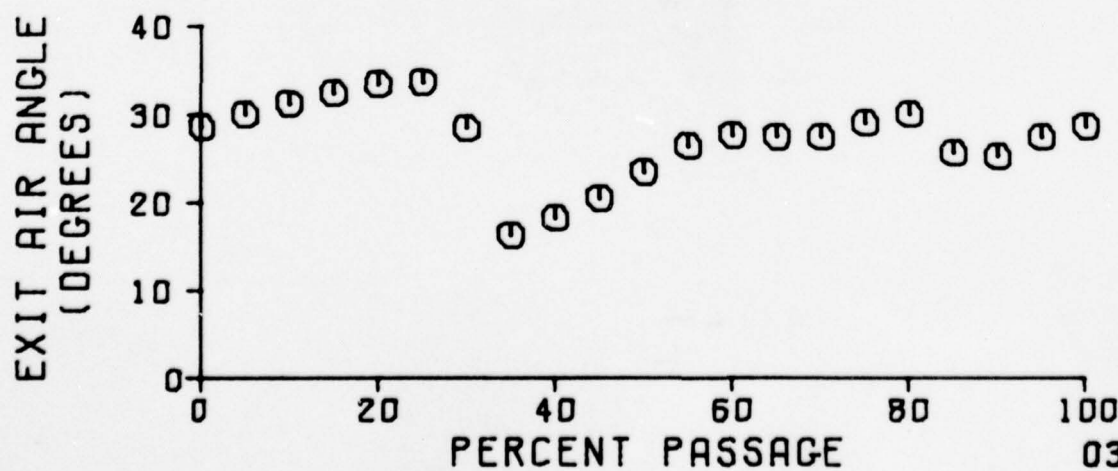
INLET MACH NUMBER = 1.458

STATIC PRESSURE RATIO = 1.956

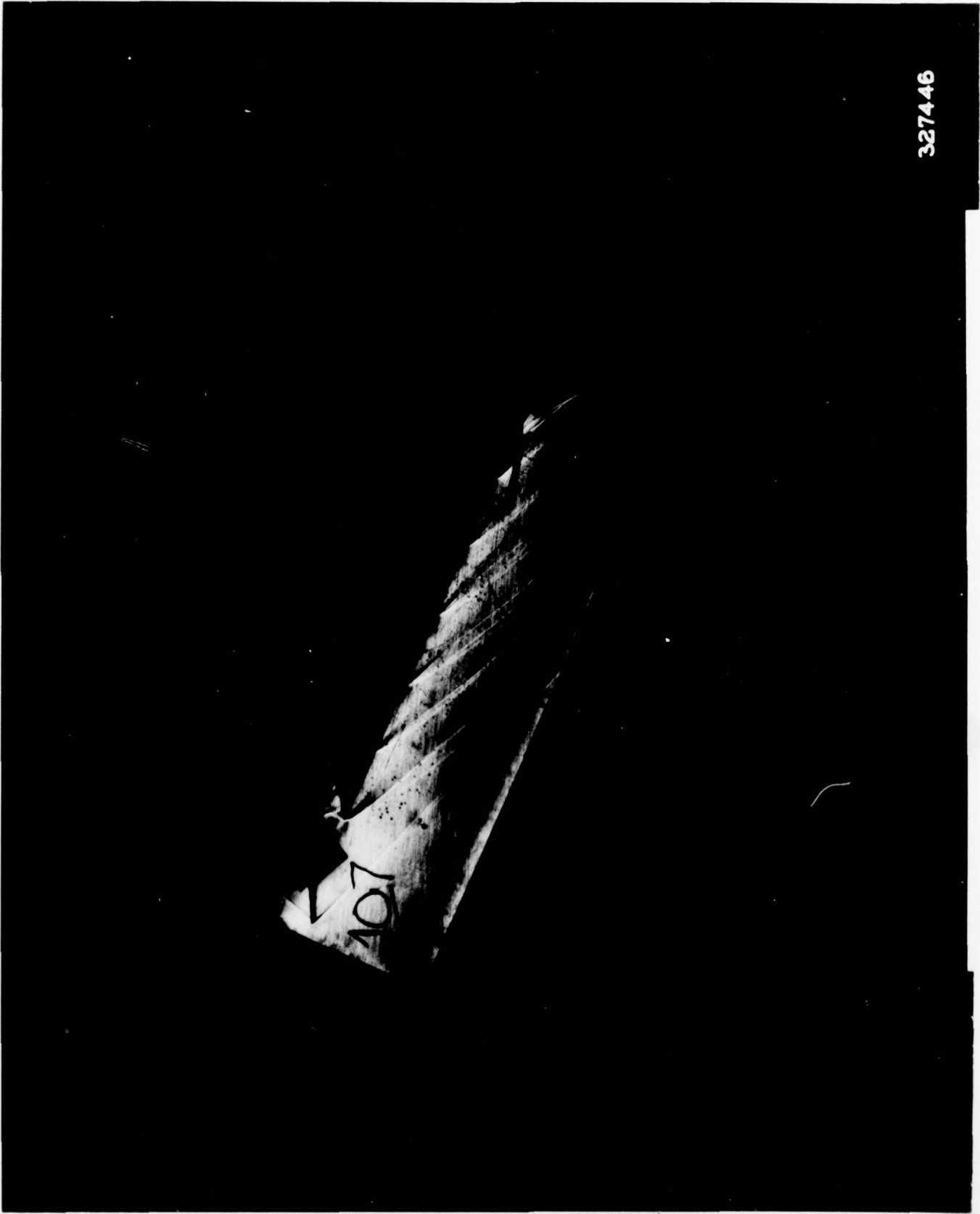
03/01/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.956



03/01/77



327446

CASCADE INLET SCHLIEREN - $MN(1) = 1.46$, $P(2/P)1 = 1.956$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.458	1.851	4	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
7.869	1.503	58.030	24.375	563.148

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.225	43.168	1.458	1.000	1.002

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	19.875	19.874	19.879	19.872
11	18.022	6.599	10.134	1.738
13	11.458	9.381	10.710	5.476
15	12.132	10.047	11.863	4.823
17	11.748	14.442	11.093	7.405
19	11.780	11.166	9.596	7.646
21	19.812	10.064	8.710	8.574
23	10.423	14.445	10.042	9.269
25	10.616	10.065	11.703	9.824
27	10.708	12.227	12.126	10.169
29	10.637	10.911	11.252	10.466
31	10.552	14.454	10.779	19.852
33	10.792	10.710	10.767	2.030
35	10.526	11.487	10.762	2.648
37	10.483	10.691	10.761	1.633
39	10.690	14.440	10.576	1.589
41	10.993	11.353	10.564	1.821
43	19.861	14.450	12.290	8.745
45	4.956	19.830	12.741	6.613
47	19.850	19.855	19.868	6.607

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.245	43%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS.

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.084	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE	
PS	SS	ML	ML	
(DEGREES)			(DEG.)	
61.417	65.479	63.448	22.534	

NOZZLE EXIT CONDITIONS

NN0	PT0	TT0	M0	BETA0
1.500	19.845	563.148	8.966	65.625

CASCADE INLET CONDITIONS

NN1	PT1	TT1	BETA1	P1	M1	Q1
1.458	19.845	563.148	66.850	5.741	.241	8.546
IS5	IML	NN1Y,1	NN1Y,1	TT/TT1	PT/P1	NR/10**6
1.371	3.402	.573	1.341	1.425	3.457	1.425

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.423	33	10.792
25	10.516	35	10.526
27	10.706	37	10.463
29	10.637	39	10.690
31	10.552	41	10.993

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P2/P1)
10.587	.096	10.697	.165	.992	1.844

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.779
		33	10.767
		35	10.762
		37	10.761
		39	10.576
		41	10.564

MEAN TRAILING EDGE PRESSURE [PSIA] 10.702 RMS DEVIATION .093

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.030 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.648 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.633 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.589 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.734 F
SIDEWALL BLEED ORIFICE PRESSURE	=	1.821 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.083 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.395 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.096

82581

421

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.134	5.476	.514	-.031	.511	.276	13.89	13.45
13	10.710	5.476	.582	-.031	.540	.276	26.98	26.63
15	11.863	4.823	.716	-.107	.598	.243	39.60	39.24
17	11.093	7.405	.626	.195	.559	.373	49.87	48.78
19	9.596	7.646	.451	.223	.484	.385	57.88	57.75
21	8.710	8.574	.347	.332	.439	.432	66.20	66.09
23	10.042	9.269	.503	.413	.506	.467	73.41	73.77
25	11.703	9.824	.698	.478	.590	.495	81.70	82.41
27	12.126	10.169	.747	.518	.611	.512	89.05	89.97
29	11.252	10.466	.645	.553	.567	.527	96.93	97.73
0	10.669	10.669	.577	.577	.538	.538	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CL)1	CL)1	FC)LE	CP)LE
.353	-.296	.193	-33.111	-.028	.352	.119	33.618

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.290	8.745	.766	.352	.619	.441	95.57	93.37
45	12.741		.819		.642		110.63	
47		6.697		.101		.333		109.00

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT1YR	MA12 TURN P1TP	MN1Y,2 M12 P1BP	MN1Y,2 DP1,2 P1AP	PT12 V12 P1SP	P12 PT10 BETA1P	PT12/PT11 PT10 PT11	BETA12 PT10,A T111
.20	6.284	.863	.760	.409	18.224	11.207	.918	28.252
	5.716	38.600	.000	1.621	936.720	19.866	19.789	19.827
	18.224	11.391	12.092	11.678	11.814	-3.710	19.827	563.493
5.00	6.363	.879	.764	.433	18.533	11.214	.934	29.537
	7.003	37.313	.028	1.312	951.157	19.863	19.815	19.839
	18.533	11.578	12.054	11.639	11.892	-2.433	19.838	563.493
9.00	6.442	.863	.742	.441	18.411	11.322	.928	30.752
	8.218	36.898	.028	1.433	936.720	19.873	19.818	19.845
	18.411	11.701	11.934	11.905	11.870	-1.213	19.845	563.493
14.00	6.521	.834	.707	.442	17.869	11.328	.900	32.019
	9.485	34.831	.027	1.975	908.881	19.870	19.830	19.850
	17.869	11.742	11.734	11.838	11.796	.049	19.850	563.838
19.00	6.600	.754	.631	.413	16.642	11.413	.839	33.172
	10.636	33.680	.025	3.203	831.374	19.856	19.800	19.828
	16.642	11.703	11.526	11.743	11.691	1.200	19.828	563.493
24.00	6.679	.629	.524	.347	14.906	11.423	.751	33.548
	11.014	33.302	.021	4.939	703.865	19.854	19.812	19.833
	14.906	11.617	11.453	11.549	11.508	1.588	19.833	563.493
29.00	6.758	.445	.393	.209	13.002	11.348	.655	27.956
	5.422	38.894	.016	6.843	507.784	19.887	19.834	19.861
	13.002	11.475	11.670	11.290	11.260	-4.014	19.860	563.493

62581

422

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

A12 0,4 11	PERCT	Y DEV PT1YP	M12 TURN PT1P	M1Y,2 M12 P1BP	M1Y,2 DP11,2 P11P	PT12 V12 P1SP	P12 PT10 RETA1P	PT12/PT11 PT10 PT11	RETA12 PT10,4 TT11
252 827 493	35.24	6.838 -5.913 13.160	.460 50.229 11.297	.440 .015 12.096	.131 6.685 11.171	13.160 523.586 11.161	11.386 19.860 -15.349	.663 19.830 19.845	16.621 19.845 563.493
537 839 493	40.24	6.917 -3.919 14.636	.606 48.235 11.163	.575 .018 12.433	.194 5.208 11.134	14.636 680.724 11.157	11.418 19.884 -13.355	.738 19.831 19.857	18.615 19.857 563.493
752 845 493	45.24	6.996 -2.104 16.294	.730 46.420 11.039	.684 .023 12.624	.255 3.551 11.262	16.294 806.834 11.330	11.435 19.857 -11.530	.821 19.809 19.833	20.434 19.833 563.493
019 850 838	50.23	7.075 1.032 17.811	.837 43.284 11.073	.767 .027 12.867	.335 2.034 11.465	17.811 912.038 11.606	11.253 19.863 -8.404	.898 19.815 19.838	23.566 19.839 563.838
172 828 493	55.23	7.154 3.823 18.536	.885 40.493 11.241	.793 .029 12.345	.393 1.309 11.587	18.536 956.831 11.826	11.143 19.856 -5.613	.934 19.806 19.832	26.357 19.832 563.493
548 833 493	60.23	7.233 5.175 18.113	.863 39.141 11.354	.764 .028 12.150	.401 1.732 11.515	18.113 936.373 11.795	11.143 19.849 -4.251	.913 19.829 19.838	27.709 19.839 563.493
956 861 493	65.22	7.312 5.026 17.424	.812 39.290 11.346	.720 .027 12.088	.376 2.421 11.421	17.424 887.498 11.708	11.298 19.855 -4.400	.878 19.803 19.829	27.560 19.829 563.493

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN PT)TP	MN)X,2 M)2 PT)BP	MN)Y,2 DP)1,2 PT)MP	PT)2 V)2 PT)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
70.02	7.391 4.024 17.247	.803 39.392 11.310	.713 .026 12.053	.370 2.598 11.395	17.247 879.169 11.685	11.280 19.876 -4.502	.869 19.820 19.848	27.458 19.848 563.838
75.02	7.470 6.102 17.373	.820 38.214 11.289	.720 .026 11.857	.393 2.471 11.405	17.373 895.915 11.721	11.167 19.846 -3.334	.875 19.806 19.825	28.636 19.826 563.493
80.01	7.540 6.919 16.810	.786 37.397 11.300	.684 .026 11.702	.386 3.035 11.297	16.810 862.306 11.580	11.184 19.863 -2.507	.847 19.815 19.839	29.453 19.839 563.838
85.01	7.628 2.634 15.258	.668 41.882 11.199	.605 .023 11.980	.284 4.587 11.175	15.258 744.749 11.338	11.310 19.858 -6.802	.769 19.848 19.852	25.168 19.853 563.493
90.01	7.707 2.488 16.859	.776 41.828 11.150	.703 .024 12.224	.328 2.986 11.407	16.859 852.636 11.518	11.325 19.871 -6.948	.850 19.816 19.843	25.022 19.843 563.838
95.00	7.786 4.513 18.073	.857 39.803 11.277	.764 .027 12.191	.390 1.772 11.658	18.073 931.216 11.742	11.182 19.871 -4.923	.911 19.830 19.850	27.047 19.851 563.838
100.00	7.865 5.809 18.078	.849 38.507 11.458	.748 .028 12.125	.403 1.767 11.771	18.078 923.586 11.799	11.280 19.868 -3.627	.911 19.814 19.840	28.343 19.841 563.493

62581

423

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO. 10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MM12 BETA12 PT12/PT11

.779 27.133 .858

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MM1X,2	MM1Y,2	PT12	P12	TT12	TT12/T12	M12/M11
.694	.355	17.030	11.400	563.148	1.122	.956

MIXED EXIT CONDITIONS

MM1X,2	MM1Y,2	PT12	P12	TT12	TT12/T12	MM12	BETA12
.657	.355	16.790	11.593	563.148	1.112	.747	28.353

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

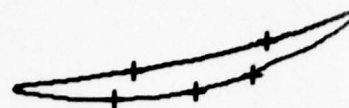
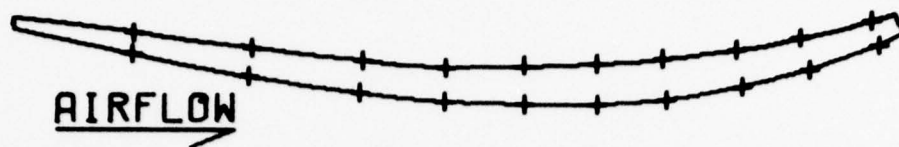
P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DE	DE/EO	OVY	RN2	DPS/O1	DEV	TURN
BETA/C	A2/A1						
1.986	.858	.603	1.364	.299	1.563	1.271	.203
.047	.567	1.994	.645	1.121	.662	4.599	39.717
26.579	.469						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P2/P1	PT2/PT1	V2/V1	V2/V1,X	V2/V1,Y	R2/R1	T2/T1	OMEGA
TPLP	DE	DE/EO	OVY	RN2	DPS/O1	DEV	TURN
BETA/C	A2/A1						
2.019	.846	.580	1.299	.300	1.575	1.282	.217
.050	.589	2.071	.644	1.080	.665	5.819	38.497
22.961	.489						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



BLADE

▲ P.S.

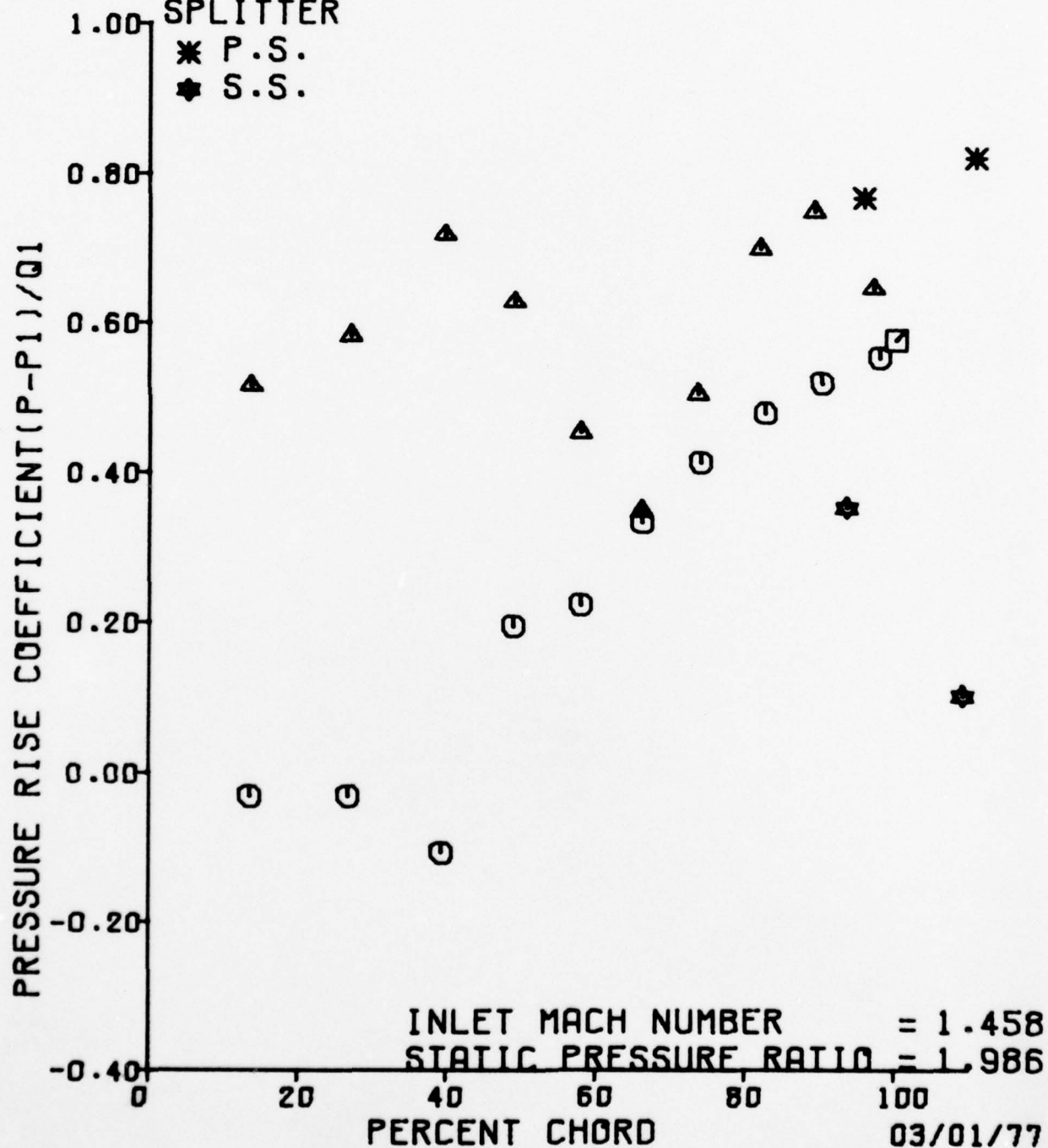
○ S.S.

◻ T.E.

SPLITTER

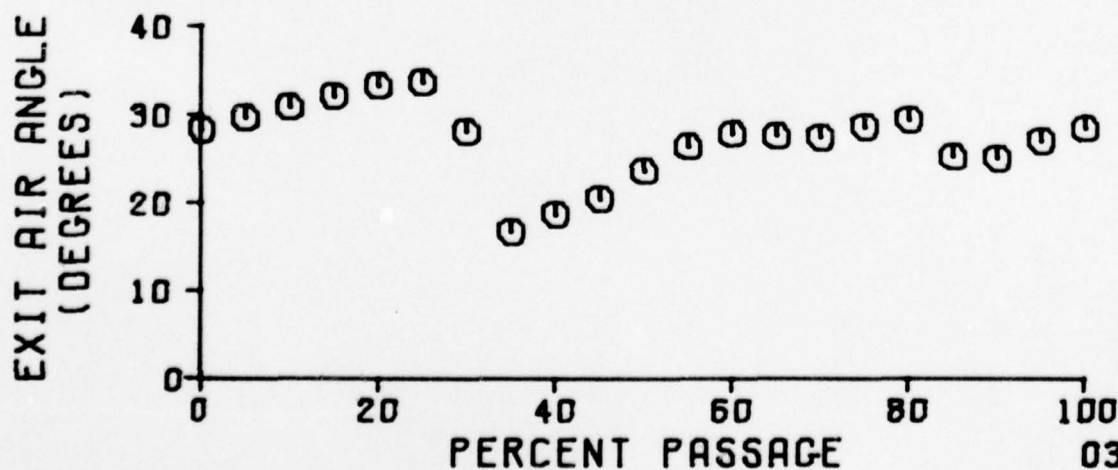
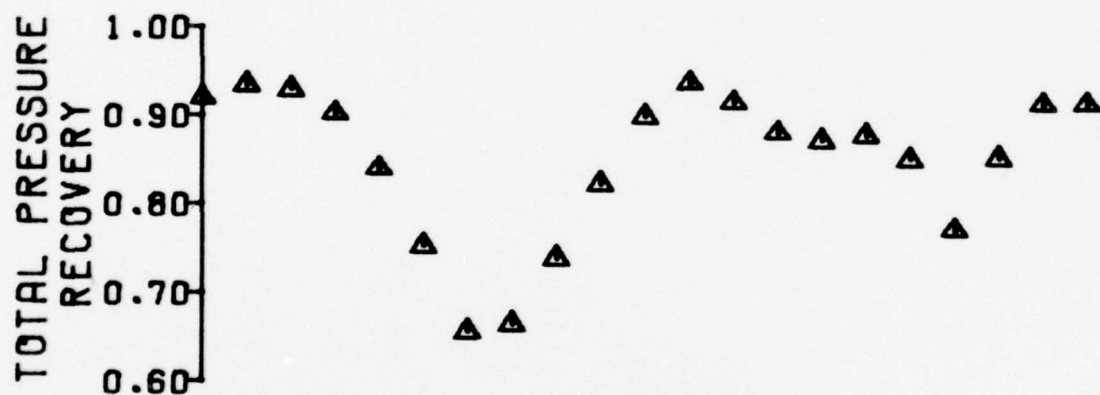
* P.S.

★ S.S.



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.458
CASCADE STATIC PRESSURE RATIO = 1.986



03/01/77



108
Z

327447

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.986



327447

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.986

APPENDIX J

CASCADE DATA

SPLITTER VANE POSITION = 38%

$$P)_2/P)_1 = 1.593$$

$$P)_2/P)_1 = 1.844$$

$$P)_2/P)_1 = 1.984$$

$$P)_2/P)_1 = 2.057$$

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.540	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.960	1.501	57.550	24.330	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.421	20.445	20.443	20.432
11	18.951	6.744	6.077	12.335
13	10.857	8.588	10.152	5.530
15	12.055	8.131	11.214	4.936
17	11.342	14.510	11.812	4.675
19	11.306	6.796	10.232	5.181
21	20.370	8.125	8.997	6.001
23	8.985	14.512	8.559	6.815
25	9.083	9.174	7.619	7.512
27	9.195	11.346	8.111	7.904
29	8.649	11.335	9.699	8.476
31	9.422	14.523	8.821	20.461
33	9.152	9.289	8.814	2.169
35	9.179	9.499	8.808	2.832
37	9.067	8.686	8.808	1.604
39	8.687	14.508	8.601	1.573
41	9.490	9.848	8.592	1.816
43	20.416	14.515	9.562	9.043
45	5.147	20.455	1.742	6.797
47	20.397	20.390	20.429	1.953

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	38%

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.500	20.396	561.079	9.232	65.670

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	20.395	561.079	66.850	5.887	.247	8.782
I)SS	I)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.470

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	8.985	33	9.152
25	9.083	35	9.179
27	9.195	37	9.267
29	8.649	39	8.687
31	9.422	41	9.490

MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
9.067	.255	9.115	.258	1.142	1.540

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	8.821
		33	8.814
		35	8.808
		37	8.808
		39	8.601
		41	8.592

MEAN TRAILING EDGE PRESSURE [PSIA] 8.741 RMS DEVIATION .102

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.169 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.832 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.604 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.573 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.818 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.311 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.073

62531

432

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	6.077	5.538	.022	-.041	.298	.271	13.69	13.45
13	10.152	5.538	.486	-.041	.498	.271	25.98	26.63
15	11.214	4.936	.607	-.108	.550	.242	39.60	39.24
17	11.812	4.675	.675	-.138	.579	.229	49.07	48.78
19	10.232	5.181	.495	-.080	.502	.254	57.88	57.75
21	8.997	6.801	.354	.013	.441	.294	66.00	66.09
23	8.559	6.815	.304	.106	.420	.334	73.41	73.77
25	7.619	7.512	.197	.185	.374	.368	81.70	82.41
27	6.111	7.984	.253	.230	.398	.388	89.05	89.97
29	9.699	8.476	.434	.295	.476	.416	96.93	97.73
3	8.785	8.785	.321	.321	.427	.427	100.00	100.00
	FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
	.324	-.266	.185	-34.859	-.016	.324	.139	42.868

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	9.562	9.043	.418	.359	.469	.443	95.57	93.37
45	1.742	6.797	-.472	.104	.085	.333	110.63	102.50
47		1.953		-.448		.096		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.80	7.391	1.149	.996	.573	19.435	8.561	.953	29.904
	7.370	36.946	.000	.959	1186.514	20.412	20.387	20.399
	19.373	11.068	11.715	11.319	11.284	-2.546	20.399	561.079
5.88	7.476	1.170	1.007	.595	19.723	8.460	.967	30.568
	8.834	36.282	.029	.672	1203.339	20.421	20.406	20.413
	19.632	11.044	11.533	11.202	11.223	-1.882	20.413	561.079
9.99	7.549	1.182	1.003	.625	19.716	8.327	.967	31.945
	9.411	34.985	.029	.679	1212.982	20.445	20.370	20.407
	19.606	10.962	11.093	10.926	10.971	-5.505	20.407	561.424
14.99	7.628	.771	.685	.353	15.672	10.580	.768	27.279
	4.745	39.571	.026	4.723	846.010	20.435	20.377	20.406
	15.672	10.654	11.390	10.495	10.707	-5.171	20.405	561.424
19.99	7.707	1.113	.991	.506	18.408	8.488	.903	27.041
	4.507	39.809	.026	1.987	1156.477	20.413	20.369	20.391
	16.386	10.458	11.734	10.847	11.111	-5.409	20.390	561.079
24.98	7.786	1.163	1.019	.562	19.524	8.443	.957	28.873
	6.339	37.977	.029	.871	1198.189	20.429	20.384	20.406
	19.443	10.725	11.640	11.237	11.251	-3.577	20.405	561.424
29.98	7.865	1.153	.995	.582	19.439	8.522	.953	30.316
	7.782	36.534	.029	.956	1189.531	20.435	20.410	20.422
	19.372	10.986	11.529	11.338	11.319	-2.134	20.422	561.079

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433

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

A)2 0,4 01	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,4 TT)1
904 399 079	35.04	7.945 8.892 19.129	1.145 35.424 11.128	.977 .029 11.384	.597 1.208 11.338	19.187 1183.396 11.320	8.492 20.431 -1.024	.941 20.378 20.404	31.426 20.405 561.424
568 413 079	40.04	8.024 10.194 19.008	1.147 34.122 11.194	.965 .028 11.124	.620 1.267 11.359	19.129 1185.324 11.277	8.441 20.431 .278	.938 20.375 20.402	32.728 20.403 561.424
945 407 424	45.04	8.103 12.124 10.108	1.073 32.192 11.227	.883 .027 10.723	.510 2.280 11.260	18.115 1123.250 11.066	8.771 20.427 2.208	.888 20.375 20.400	34.658 20.401 561.079
279 406 424	50.03	8.182 13.994 16.465	.845 30.322 11.093	.679 .025 10.412	.503 3.931 10.953	16.465 917.795 10.602	10.319 20.426 4.078	.807 20.381 20.402	36.528 20.403 561.079
041 391 079	55.03	8.261 12.482 12.934	.569 31.834 10.723	.466 .019 10.527	.327 7.461 10.420	12.934 640.772 10.165	10.380 20.421 2.566	.634 20.372 20.395	35.016 20.396 561.424
873 406 424	60.03	8.340 -13.830 11.442	.371 38.146 10.353	.366 .014 11.014	.056 8.953 10.219	11.442 424.587 10.005	10.407 20.450 -23.746	.561 20.399 20.424	8.704 20.425 561.424
316 422 079	65.02	8.419 -16.903 12.263	.486 61.219 10.123	.484 .014 11.582	.048 8.132 10.028	12.263 551.759 9.847	10.431 20.431 -26.819	.601 20.378 20.403	5.631 20.404 561.079

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)TP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	8.498 -11.220 13.808	.548 55.536 9.943	.535 .019 12.045	.127 6.527 9.929	13.868 722.382 9.855	10.460 20.451 -21.136	.680 20.412 20.431	11.314 20.431 561.079
75.02	8.577 -6.839 15.992	.805 51.155 9.830	.775 .024 12.392	.218 4.403 10.134	15.992 879.329 10.200	10.440 20.438 -16.755	.784 20.383 20.410	15.695 20.411 561.079
80.01	8.555 -2.703 17.821	.930 47.019 9.987	.874 .028 12.488	.315 2.574 10.577	17.821 996.566 10.697	10.201 20.441 -12.619	.874 20.383 20.411	19.831 20.412 561.424
85.01	8.735 1.125 16.658	1.110 43.191 10.299	1.023 .030 12.409	.448 1.696 10.993	18.699 1159.587 11.051	8.581 20.426 -6.791	.917 20.371 20.398	23.659 20.399 561.079
90.01	8.814 2.553 16.858	1.116 41.453 10.267	1.008 .030 12.302	.478 1.497 11.224	18.898 1159.166 11.209	8.679 20.440 -7.063	.927 20.401 20.420	25.387 20.420 561.079
95.00	8.893 3.889 16.880	1.108 40.427 10.703	.992 .030 12.222	.493 1.490 11.330	18.905 1152.487 11.269	8.770 20.433 -6.027	.927 20.375 20.404	26.423 20.404 561.424
100.00	8.972 4.766 16.943	1.116 39.552 10.836	.992 .030 12.093	.512 1.421 11.345	18.974 1159.483 11.284	8.710 20.419 -5.150	.930 20.390 20.404	27.300 20.405 561.079

10500

434

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

1.000 26.464 .873

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)2	M)2/M)1
.898	.447	17.800	9.376	561.079	1.201	.973

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/TT)2	MN)2	BETA)2
.743	.444	17.197	10.549	561.079	1.150	.866	30.897

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1 T)LP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.595	.673	.748	1.704	.363	1.341	1.187	.179
.042	.406	1.595	.586	1.297	.397	3.930	40.386
33.050	.438						

OVERALL PERFORMANCE

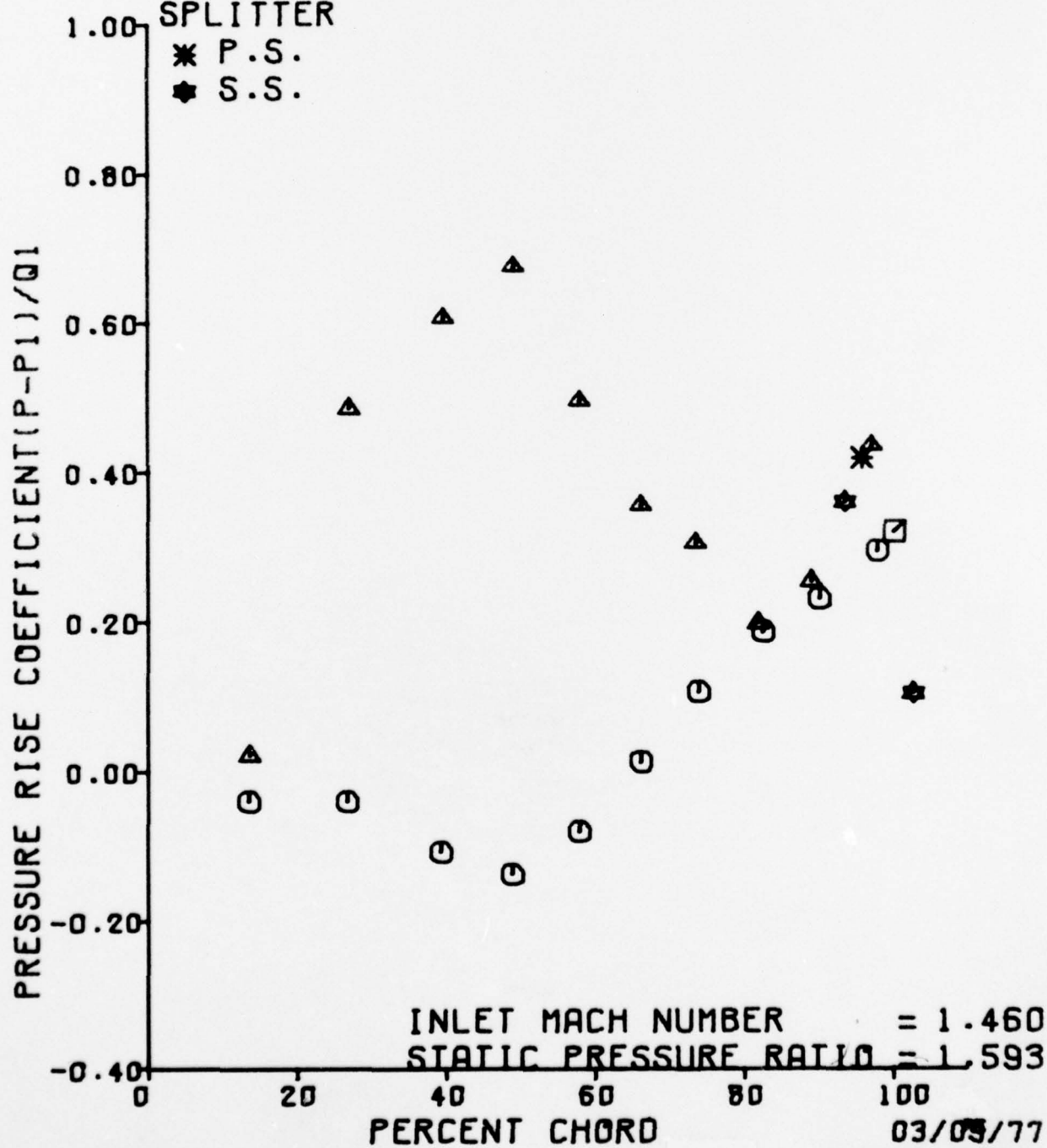
MIXED EXIT CONDITIONS

P)2/P)1 T)LP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
1.792	.843	.560	1.441	.369	1.445	1.240	.220
.050	.492	1.807	.580	1.193	.531	8.363	35.953
20.155	.480						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE



- BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.



6 2 5 3 1

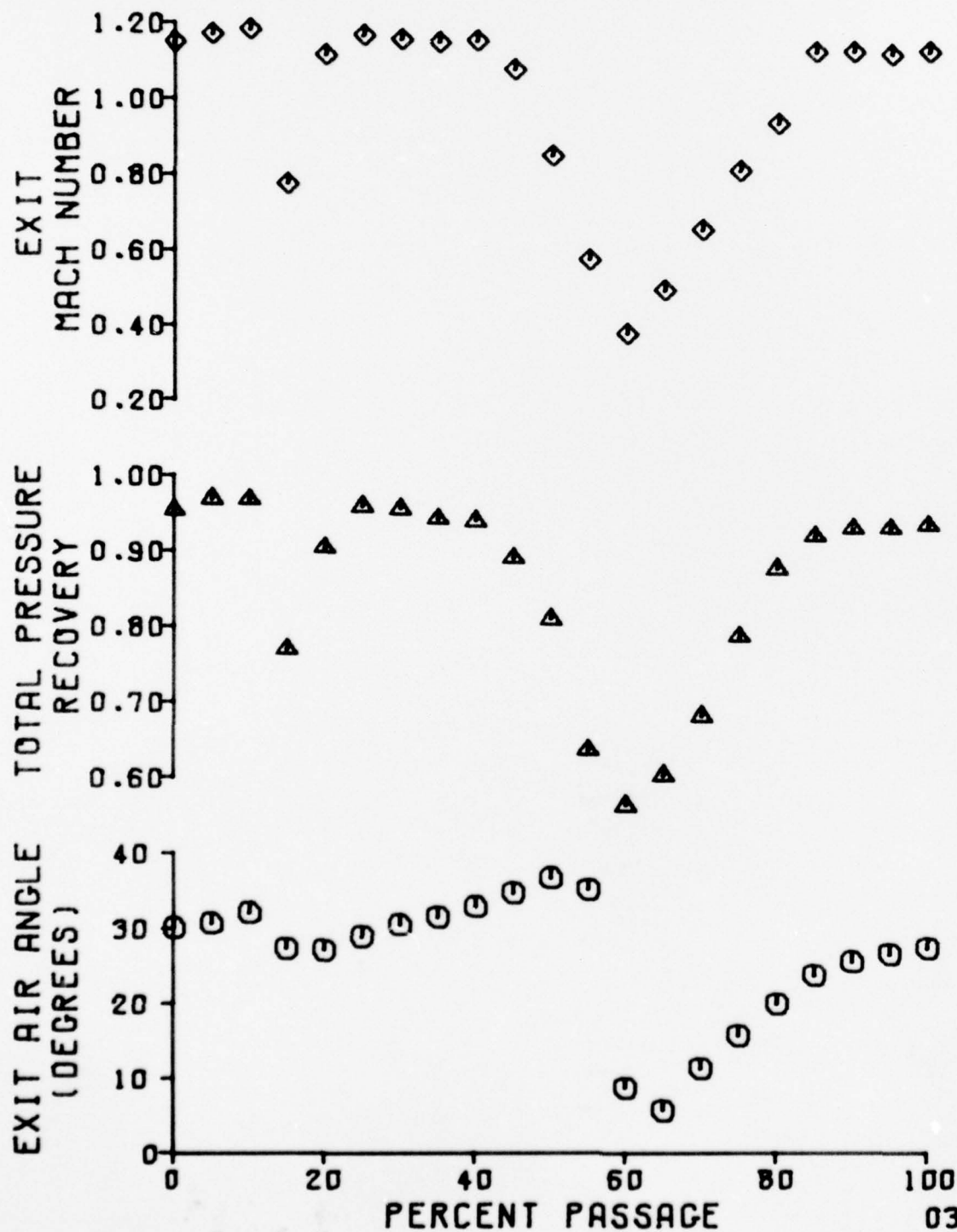
436

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03/05/77

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 4
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.593



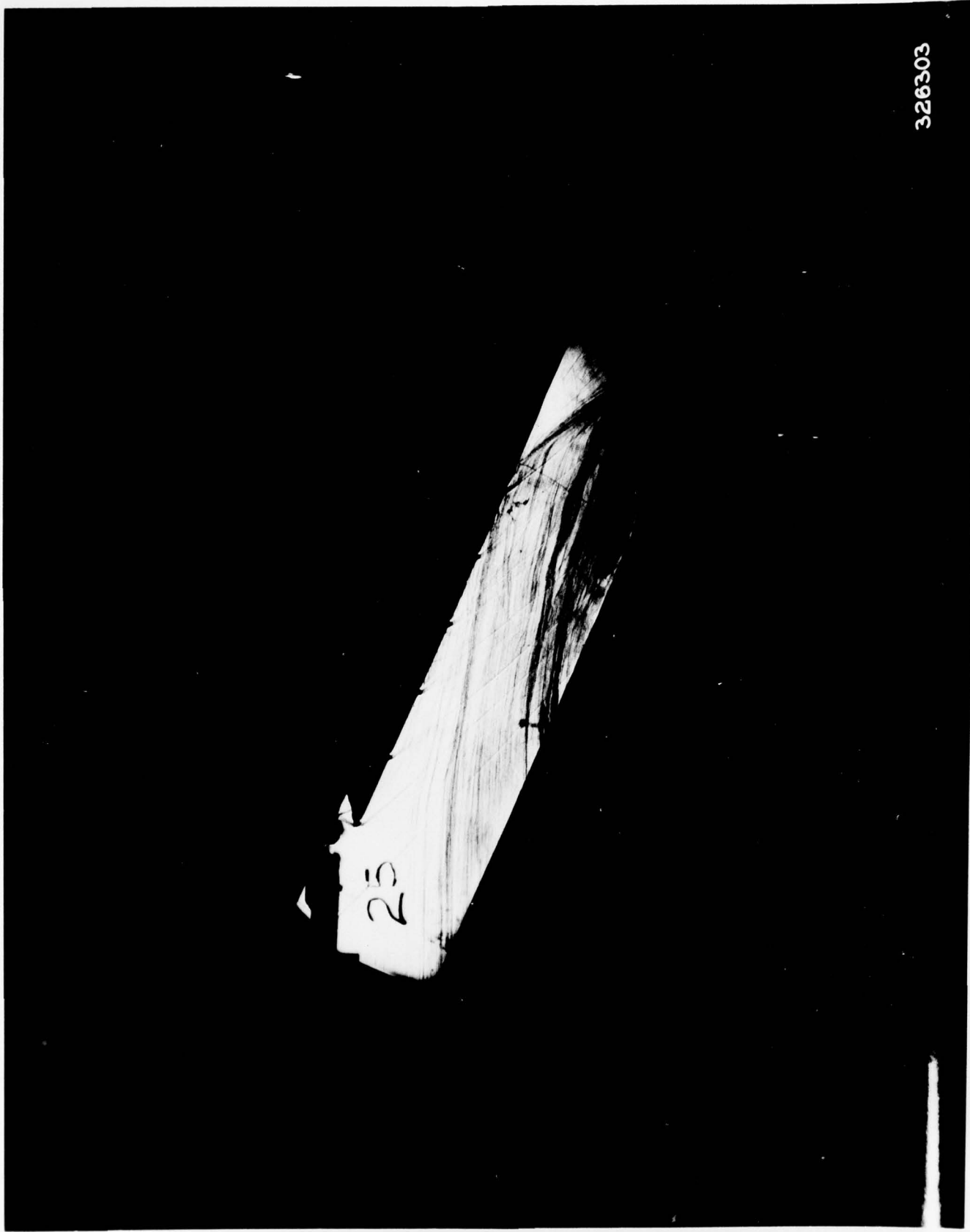
03/09/77

62 531

437

62 531

90



326303

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.593

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.540	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.976	1.501	57.550	24.330	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION + EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
9	20.501	20.496	20.523	20.513
11	18.538	6.788	7.873	11.720
13	11.291	8.840	10.113	5.547
15	12.504	8.623	12.144	5.226
17	11.736	14.505	11.970	5.499
19	11.627	10.528	10.408	5.863
21	20.488	9.345	9.206	7.170
23	9.841	14.507	8.757	8.108
25	10.049	8.914	9.370	9.028
27	10.264	12.242	11.398	9.377
29	10.161	12.241	10.581	9.893
31	9.920	14.517	10.121	20.494
33	10.128	9.826	10.115	2.134
35	9.976	10.309	10.109	2.916
37	9.896	10.055	10.106	1.623
39	10.055	14.503	10.045	1.603
41	10.465	10.961	10.035	1.497
43	20.490	14.511	12.866	9.258
45	5.148	20.485	1.789	6.970
47	20.501	20.494	20.513	2.039

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	38%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
51.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MA)0	PT)0	TT)0	M)0	BETA)0
1.500	20.497	561.079	9.277	65.670

CASCADE INLET CONDITIONS

MA)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.460	20.496	561.079	66.850	5.916	.249	8.825
I)SS	I)ML	MA)X,1	MA)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.478

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PLANE)

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	9.841	33	10.128
25	10.249	35	9.976
27	10.264	37	9.896
29	10.161	39	10.055
31	9.922	41	10.465

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
10.047	.154	10.104	.195	1.063	1.698

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.121
		33	10.115
		35	10.109
		37	10.106
		39	10.045
		41	10.035

MEAN TRAILING EDGE PRESSURE (PSIA) 10.088 RMS DEVIATION .035

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.134 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.916 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.623 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.603 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 °F
SIDEWALL BLEED ORIFICE PRESSURE	=	1.497 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.263 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.066

18581

147

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1
1
1
2
2
2
2

4
4
4

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	7.673	5.547	.222	-.042	.384	.271	13.69	13.45
13	10.113	5.547	.476	-.042	.493	.271	26.98	26.63
15	12.144	5.226	.706	-.078	.593	.255	39.60	39.24
17	11.970	5.499	.686	-.047	.584	.268	49.07	48.78
19	10.408	5.863	.509	-.006	.508	.286	57.88	57.75
21	9.206	7.170	.373	.142	.449	.350	66.02	66.09
23	8.757	8.108	.322	.246	.427	.396	73.41	73.77
25	9.370	9.028	.391	.353	.457	.440	81.70	82.41
27	11.398	9.377	.621	.392	.556	.458	89.05	89.97
29	10.581	9.693	.529	.451	.516	.483	96.93	97.73
30	10.075	10.075	.471	.471	.492	.492	100.00	100.00
	FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
	.345	-.286	.193	-34.055	-.022	.344	.136	39.531

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	12.806	9.258	.788	.379	.628	.452	95.57	93.37
45	1.789	6.970	-.468	.119	.067	.340	110.63	102.50
47		2.039		-.439		.099		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	NN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A 1T)1
.00	7.391 7.526 19.576	1.106 36.798 11.577	.957 .000 12.178	.554 .895 11.847	19.601 1150.909 11.792	9.114 20.540 -2.390	.956 20.480 20.509	30.060 20.510 560.734
5.00	7.470 8.467 19.610	1.123 35.849 11.568	.953 .030 11.936	.579 .848 11.764	19.648 1165.353 11.747	8.940 20.519 -1.449	.959 20.456 20.487	31.001 20.487 560.734
9.99	7.549 9.789 19.532	1.127 34.607 11.528	.953 .029 11.580	.601 1.124 11.554	19.372 1168.097 11.541	8.778 20.494 -2.006	.945 20.466 20.479	32.243 20.480 560.734
14.99	7.528 8.883 16.384	.772 37.513 11.257	.671 .026 11.720	.377 4.112 11.135	16.384 845.161 11.156	11.070 20.526 -3.113	.799 20.494 20.509	29.337 20.510 560.734
19.99	7.707 3.544 17.371	.632 40.772 11.203	.747 .026 12.102	.366 3.125 11.414	17.371 905.365 11.254	11.034 20.541 -6.372	.848 20.459 20.499	26.078 20.500 560.734
24.98	7.786 6.385 19.283	1.107 37.951 11.183	.969 .028 12.061	.535 1.188 11.748	19.308 1152.091 11.642	8.952 20.523 -3.551	.942 20.472 20.497	28.899 20.498 561.079
29.98	7.865 7.525 18.753	.915 36.791 11.422	.792 .029 11.914	.458 1.763 11.734	18.733 983.425 11.728	10.894 20.500 -2.391	.914 20.487 20.493	30.059 20.494 561.079

18529

2442

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)O BETA)P	PT)2/PT)1 PT)O PT)1	BETA)2 PT)O,A TT)1
32 A 1									
62 10 34	35.04	7.945 8.338 18.168	.869 35.978 11.495	.745 .028 11.795	.445 2.328 11.737	16.168 940.271 11.691	11.107 20.521 -1.578	.886 20.471 20.495	30.872 20.496 560.734
01 87 34	40.04	8.024 8.920 17.683	.835 35.390 11.485	.712 .027 11.652	.435 2.813 11.791	17.683 907.774 11.660	11.203 20.522 -1.996	.863 20.488 20.504	31.454 20.505 560.734
43 80 34	45.04	8.103 10.381 17.303	.812 33.933 11.494	.682 .026 11.416	.441 3.193 11.816	17.303 886.390 11.533	11.213 20.546 .465	.844 20.488 20.516	32.915 20.517 561.079
37 10 34	50.03	8.182 11.783 16.154	.740 32.533 11.506	.611 .024 11.245	.417 4.332 11.687	16.164 815.199 11.340	11.240 20.513 1.867	.789 20.483 20.498	34.317 20.498 560.734
78 00 34	55.03	8.261 11.627 13.640	.533 32.689 11.460	.441 .019 11.336	.299 6.856 11.314	13.640 602.135 11.129	11.240 20.528 1.711	.665 20.500 20.513	34.161 20.514 560.734
99 98 79	60.03	8.340 -2.619 12.304	.304 47.135 11.209	.342 .014 11.631	.123 8.192 11.102	12.304 416.799 11.016	11.229 20.528 -12.735	.600 20.482 20.505	19.715 20.505 560.734
59 94 79	65.02	8.419 -12.464 12.709	.423 56.780 11.053	.417 .013 12.003	.074 7.787 10.990	12.709 482.944 10.923	11.235 20.501 -22.380	.620 20.501 20.500	10.070 20.501 560.734

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	8.498 -8.985 13.796	.546 53.301 10.901	.530 .017 12.327	.128 6.700 10.932	13.796 615.356 10.916	11.269 20.545 -16.901	.673 20.503 20.523	13.549 20.524 560.734
75.02	8.577 -6.384 15.203	.565 50.700 10.771	.639 .021 12.617	.185 5.292 10.991	15.203 739.913 10.993	11.303 20.525 -16.300	.742 20.481 20.503	16.150 20.503 561.079
80.01	8.656 -2.724 16.967	.786 47.040 10.797	.740 .025 12.791	.266 3.529 11.221	16.967 861.110 11.220	11.284 20.521 -12.640	.828 20.468 20.494	19.810 20.494 560.734
85.01	8.735 .464 16.233	.870 43.652 10.949	.801 .028 12.745	.340 2.263 11.473	16.233 941.526 11.494	11.131 20.537 -9.452	.890 20.493 20.514	22.998 20.515 560.390
90.01	8.814 2.312 18.602	.891 42.004 11.119	.809 .029 12.634	.375 1.894 11.650	16.602 961.351 11.623	11.102 20.512 -7.604	.908 20.470 20.490	24.846 20.491 560.734
95.00	8.893 3.029 18.522	.881 41.287 11.225	.795 .029 12.575	.380 1.974 11.720	18.522 951.773 11.647	11.177 20.509 -6.887	.904 20.489 20.498	25.563 20.499 561.079
100.00	8.972 3.636 18.503	.880 40.080 11.276	.790 .029 12.505	.388 1.993 11.739	18.503 951.141 11.638	11.173 20.542 -6.280	.903 20.484 20.512	26.170 20.513 561.079

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.846 26.729 .850

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.756	.381	17.429	10.911	561.079	1.143	.934

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.667	.381	16.977	11.488	561.079	1.118	.768	29.702

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

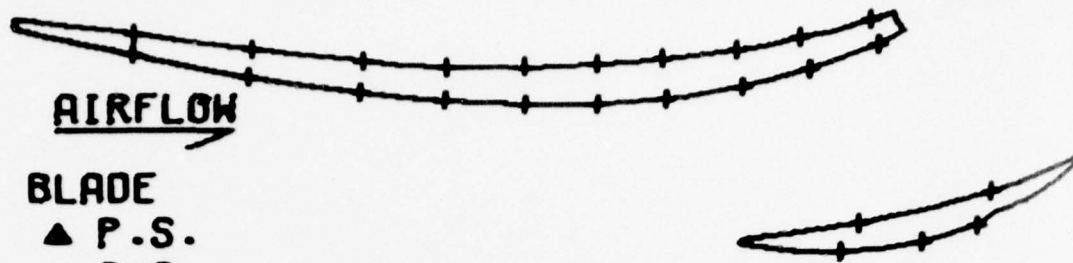
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	UV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.844	.650	.647	1.471	.317	1.478	1.248	.210
.849	.518	1.852	.628	1.198	.566	4.195	40.121
28.474	.460						

OVERALL PERFORMANCE

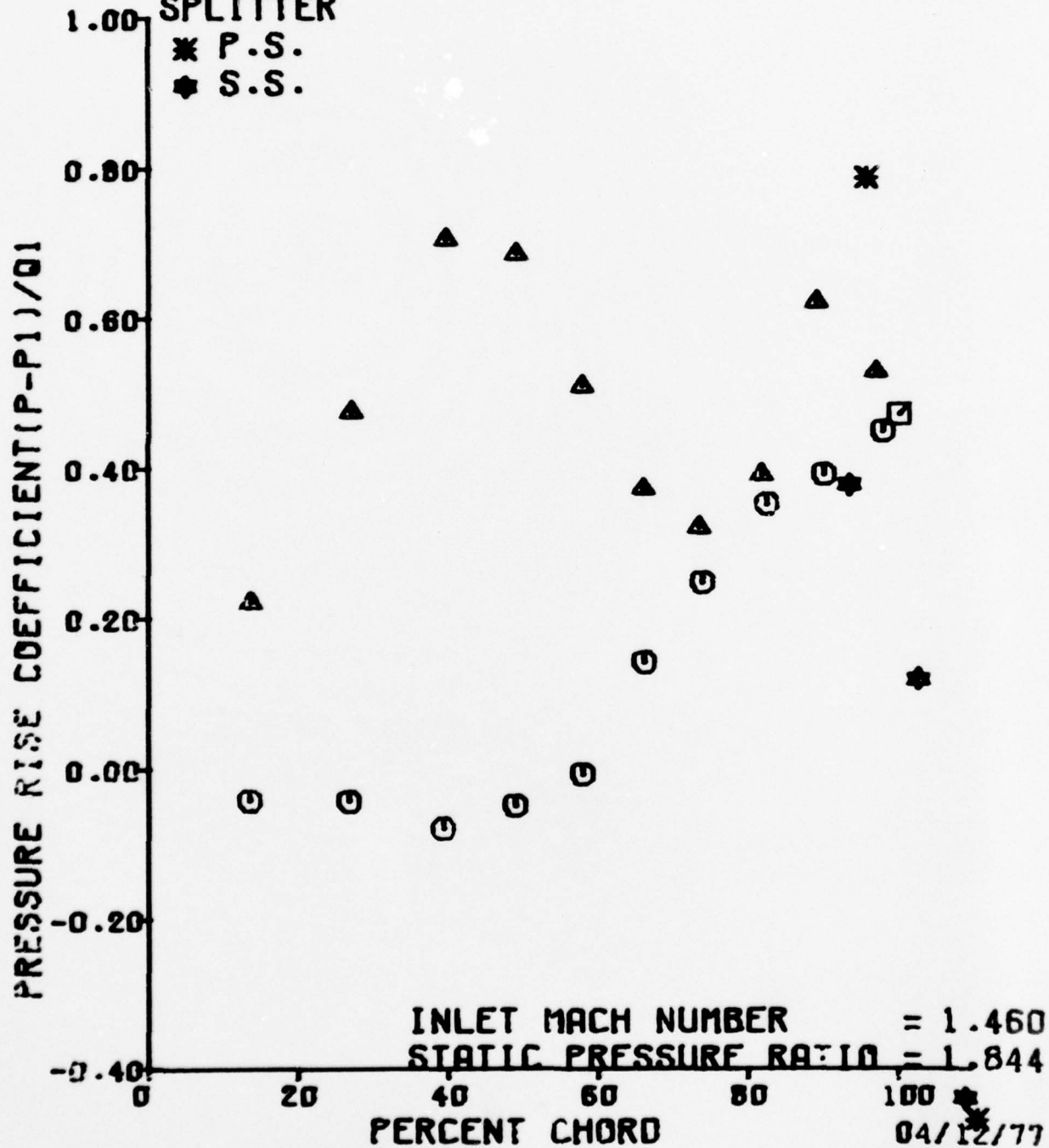
MIXED EXIT CONDITIONS

P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	UV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.942	.628	.594	1.313	.320	1.522	1.276	.241
.855	.570	2.017	.625	1.114	.631	7.168	37.148
21.500	.500						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

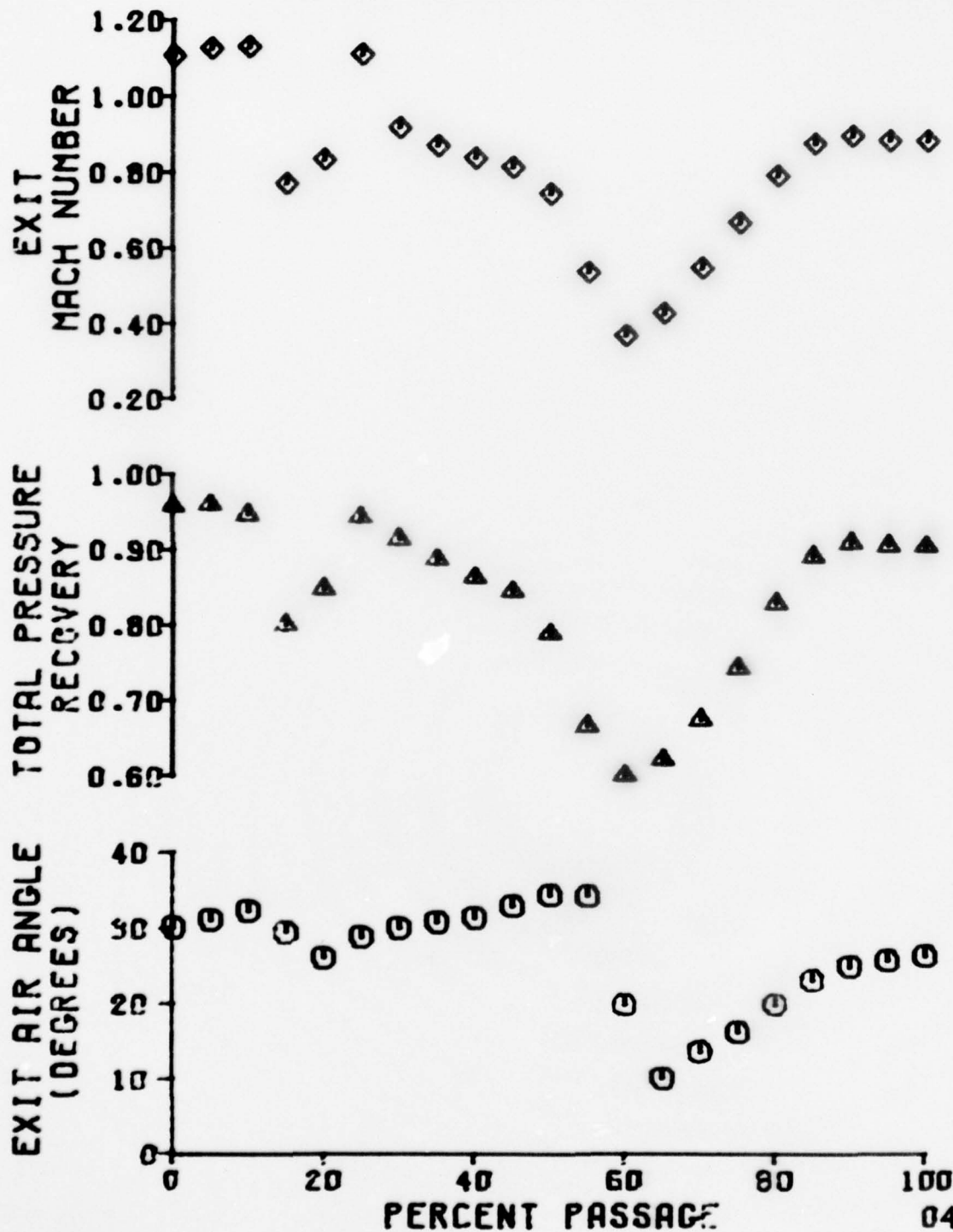


BLADE
 ▲ P.S.
 ○ S.S.
 □ T.E.
 SPLITTER
 * P.S.
 * S.S.

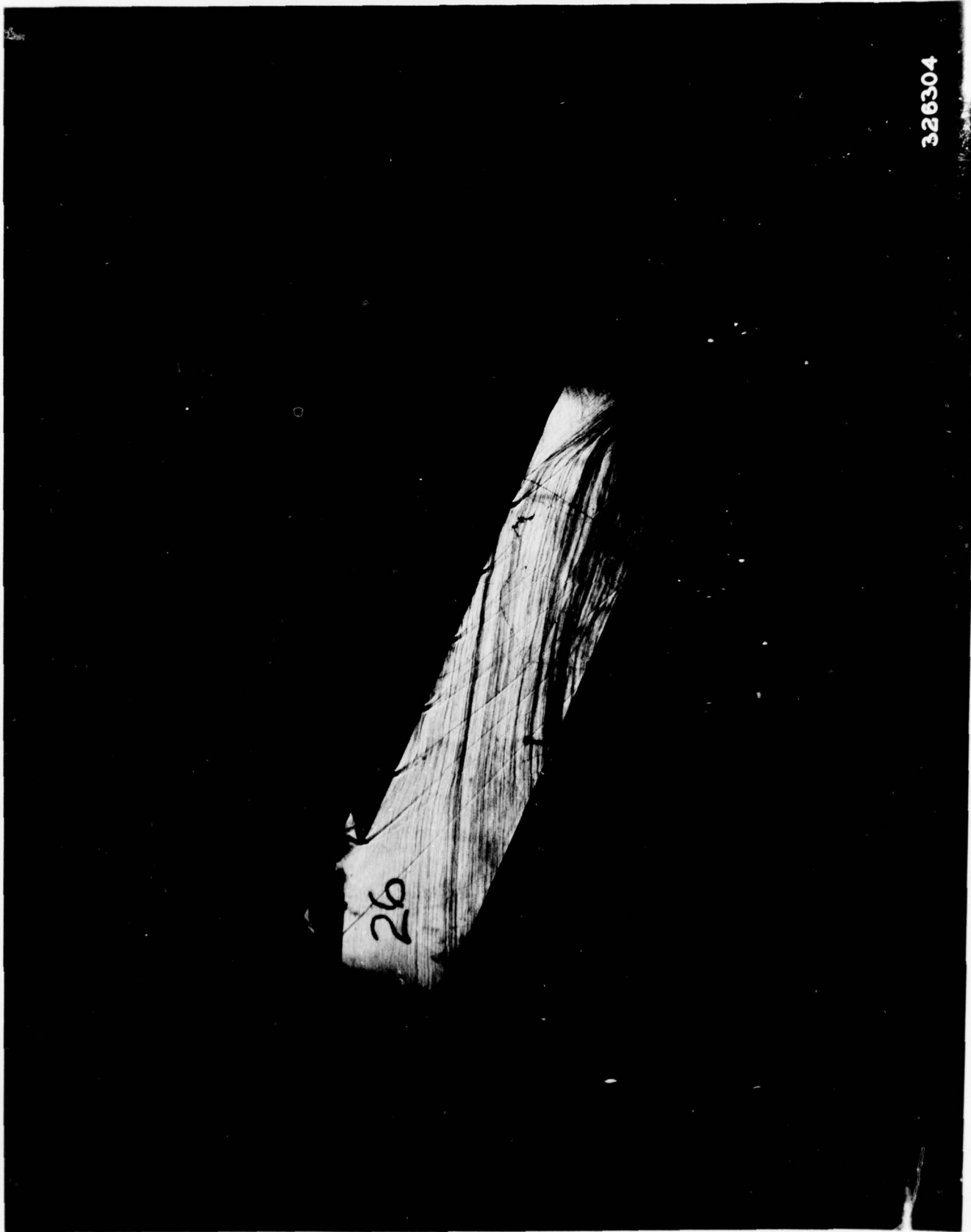


SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 5
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.844



04/12/77



326304

CASCADE INLET SCHLIEREN - MN)1 = 1.46, P)2/P)1 = 1.844

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.698	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.970	1.501	57.550	24.330	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.500	1.180	43.117	1.460	1.000	1.060

48

62531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

IAL (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	20.551	20.515	20.500	20.516
	11	18.317	6.795	9.542	11.432
	13	11.585	9.087	10.534	5.609
	15	12.741	9.868	12.340	5.613
	17	12.041	14.513	11.972	6.308
	19	11.626	11.135	10.402	6.933
	21	20.485	9.727	9.233	8.160
	23	10.479	14.513	8.946	8.991
	25	10.637	8.720	11.169	9.699
	27	10.797	12.573	11.975	10.089
	29	10.693	12.580	11.150	10.581
	31	10.512	14.522	10.773	20.483
	33	10.761	10.517	10.761	2.158
	35	10.601	10.821	10.756	2.978
	37	10.539	10.664	10.754	1.659
	39	10.660	14.507	10.708	1.632
	41	11.018	11.471	10.702	1.461
	43	20.511	14.515	13.013	9.292
	45	5.136	20.476	1.815	7.040
	47	20.514	20.503	20.530	2.083

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION
39.750	1.185	.045	38%

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.316	3.044	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MM)0	PT)0	TT)0	M)0	BETA)0
1.588	20.517	561.079	9.286	65.670

CASCADE INLET CONDITIONS

MM)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.458	20.516	561.079	66.850	5.922	.249	8.834
I)53	I)ML	MM)X,1	MM)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.482	.574	1.342	1.426	3.464	1.479

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDENALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.479	33	10.761
25	10.637	35	10.601
27	10.797	37	10.539
29	10.693	39	10.660
31	10.512	41	11.018

MEAN EXIT STATIC PRESSURE (PSIA)	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE (PSIA)	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1)
10.923	.117	10.716	.168	1.017	1.794

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	10.773
		33	10.761
		35	10.756
		37	10.754
		39	10.708
		41	10.702

MEAN TRAILING EDGE PRESSURE (PSIA) 10.742 RMS DEVIATION .027

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.158 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.978 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.659 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.632 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	551.079 °R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.461 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.279 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.065

62581

450

14
15
16
17
18
21
23
25
2
2

43
43
47

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	9.342	5.689	.410	-.035	.465	.273	13.69	13.45
13	10.534	5.689	.522	-.035	.513	.273	26.98	26.63
15	12.340	5.613	.727	-.035	.601	.274	39.60	39.24
17	11.972	6.368	.685	.044	.584	.307	49.07	48.78
19	10.402	6.933	.507	.115	.507	.338	57.88	57.75
21	9.203	8.168	.375	.253	.450	.398	66.00	66.09
23	6.946	6.991	.342	.347	.436	.438	73.41	73.77
25	11.109	9.699	.594	.426	.544	.473	81.70	82.41
27	11.976	10.089	.685	.472	.564	.492	89.05	89.97
29	11.100	10.581	.592	.527	.543	.516	96.93	97.73
3	10.731	10.731	.544	.544	.523	.523	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.351	-.294	.193	-33.338	-.027	.350	.126	35.785

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	13.013	9.292	.803	.381	.634	.453	95.57	93.37
45	1.615	7.846	-.465	.127	.088	.343	110.63	102.50
47		2.883		-.435		.102		109.00

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PTJYP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 P)D BETA)P	PT)2/PT)1 P)D PT)1	BETA)2 PT)D,A TT)1
.00	7.391 6.313 18.894	.883 38.003 11.718	.773 .000 12.441	.426 1.522 11.969	18.894 953.150 12.022	11.383 20.528 -3.503	.921 20.487 20.507	28.847 20.508 561.079
5.00	7.470 7.353 19.038	.906 36.933 11.729	.785 .029 12.255	.452 1.478 11.938	19.038 974.950 12.025	11.183 20.527 -2.533	.928 20.506 20.516	29.917 20.517 561.079
9.99	7.549 6.838 19.058	.919 35.478 11.755	.785 .029 11.982	.479 1.458 11.837	19.058 987.111 11.914	11.034 20.524 -1.078	.929 20.474 20.498	31.372 20.499 560.734
14.99	7.628 7.036 16.774	.757 37.260 11.623	.658 .027 12.049	.374 3.742 11.559	16.774 832.626 11.584	11.473 20.505 -2.860	.818 20.455 20.479	29.590 20.480 561.079
19.99	7.707 4.019 16.916	.761 40.297 11.410	.681 .025 12.301	.340 3.680 11.743	16.916 836.464 11.567	11.527 20.508 -5.897	.825 20.459 20.483	26.553 20.483 561.079
24.98	7.786 5.568 16.522	.670 38.748 11.476	.768 .027 12.316	.410 1.994 11.915	16.522 941.800 11.841	11.304 20.536 -4.348	.903 20.484 20.509	28.102 20.510 560.734
29.98	7.865 6.856 16.324	.850 37.460 11.648	.741 .028 12.219	.417 2.192 11.964	16.324 922.589 11.947	11.424 20.535 -3.060	.893 20.488 20.511	29.390 20.512 561.079

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

	PERCT	T DEV PTJYP	MN)2 TURN P)JTP	MN)X,2 M)2 P)BP	MN)Y,2 OP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
47 48 79	35.04	7.945 7.334 17.907	.811 36.982 11.739	.704 .028 12.167	.404 2.609 12.049	17.907 885.528 11.979	11.616 20.560 -2.582	.873 20.529 20.544	29.868 20.545 560.734
17 17 79	40.04	8.024 7.996 17.554	.786 36.320 11.751	.677 .026 12.066	.399 2.962 12.111	17.554 861.191 11.977	11.673 20.512 -1.920	.856 20.457 20.483	30.530 20.484 561.079
72 99 34	45.04	8.103 9.386 17.248	.764 34.930 11.794	.648 .025 11.876	.404 3.268 12.230	17.248 839.154 11.994	11.722 20.504 -.530	.841 20.464 20.484	31.920 20.484 560.734
90 90 79	50.03	8.162 11.563 16.430	.710 32.733 11.688	.588 .023 11.664	.398 4.086 12.163	16.430 785.462 11.919	11.742 20.511 1.667	.801 20.492 20.501	34.117 20.502 561.079
53 83 79	55.03	8.261 13.523 14.454	.554 30.793 11.960	.448 .019 11.665	.320 6.062 11.855	14.454 624.818 11.766	11.730 20.532 3.607	.705 20.490 20.511	36.057 20.511 561.079
72 10 84	60.03	8.340 13.094 12.882	.379 31.222 11.879	.308 .014 11.773	.221 7.634 11.595	12.882 433.960 11.625	11.666 20.523 3.178	.628 20.485 20.504	35.628 20.504 561.079
90 12 79	65.02	8.419 -7.847 12.559	.315 32.163 11.849	.305 .011 11.974	.080 7.957 11.522	12.559 362.142 11.608	11.725 20.527 -17.763	.612 20.484 20.505	14.687 20.505 561.079

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
70.02	8.498	.413	.399	.109	13.124	11.667	.640	15.337
	-7.197	51.513	.013	7.392	472.092	20.506	20.478	20.492
	13.124	11.484	12.196	11.505	11.615	-17.113	20.492	560.734
75.02	8.577	.513	.490	.152	14.040	11.733	.684	17.208
	-5.326	49.642	.016	6.476	580.414	20.520	20.475	20.498
	14.040	11.391	12.440	11.586	11.579	-15.242	20.497	561.079
80.01	8.658	.627	.590	.212	15.325	11.754	.747	19.770
	-2.764	47.080	.020	5.191	701.463	20.541	20.500	20.520
	15.325	11.354	12.687	11.694	11.538	-12.680	20.519	560.734
85.01	8.735	.751	.696	.281	17.052	11.735	.831	22.022
	-1.512	44.628	.024	3.464	826.188	20.492	20.460	20.476
	17.052	11.359	12.919	11.866	11.609	-10.428	20.475	561.079
90.01	8.814	.836	.762	.345	18.335	11.596	.894	24.396
	1.862	42.454	.028	2.181	909.418	20.517	20.475	20.496
	18.335	11.449	12.924	12.027	11.729	-8.054	20.496	560.734
95.00	8.893	.855	.770	.371	18.612	11.545	.907	25.691
	3.157	41.159	.029	1.904	927.215	20.499	20.480	20.489
	18.612	11.537	12.825	12.099	11.835	-6.759	20.489	561.079
100.00	8.972	.837	.751	.370	18.356	11.602	.895	26.223
	3.689	40.827	.029	2.160	909.992	20.501	20.491	20.496
	18.356	11.580	12.731	12.060	11.841	-6.227	20.495	560.734

50591

452

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.756 27.388 .836

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.671	.348	17.154	11.747	561.079	1.114	.862

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.684	.347	16.759	12.124	561.080	1.097	.696	29.884

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

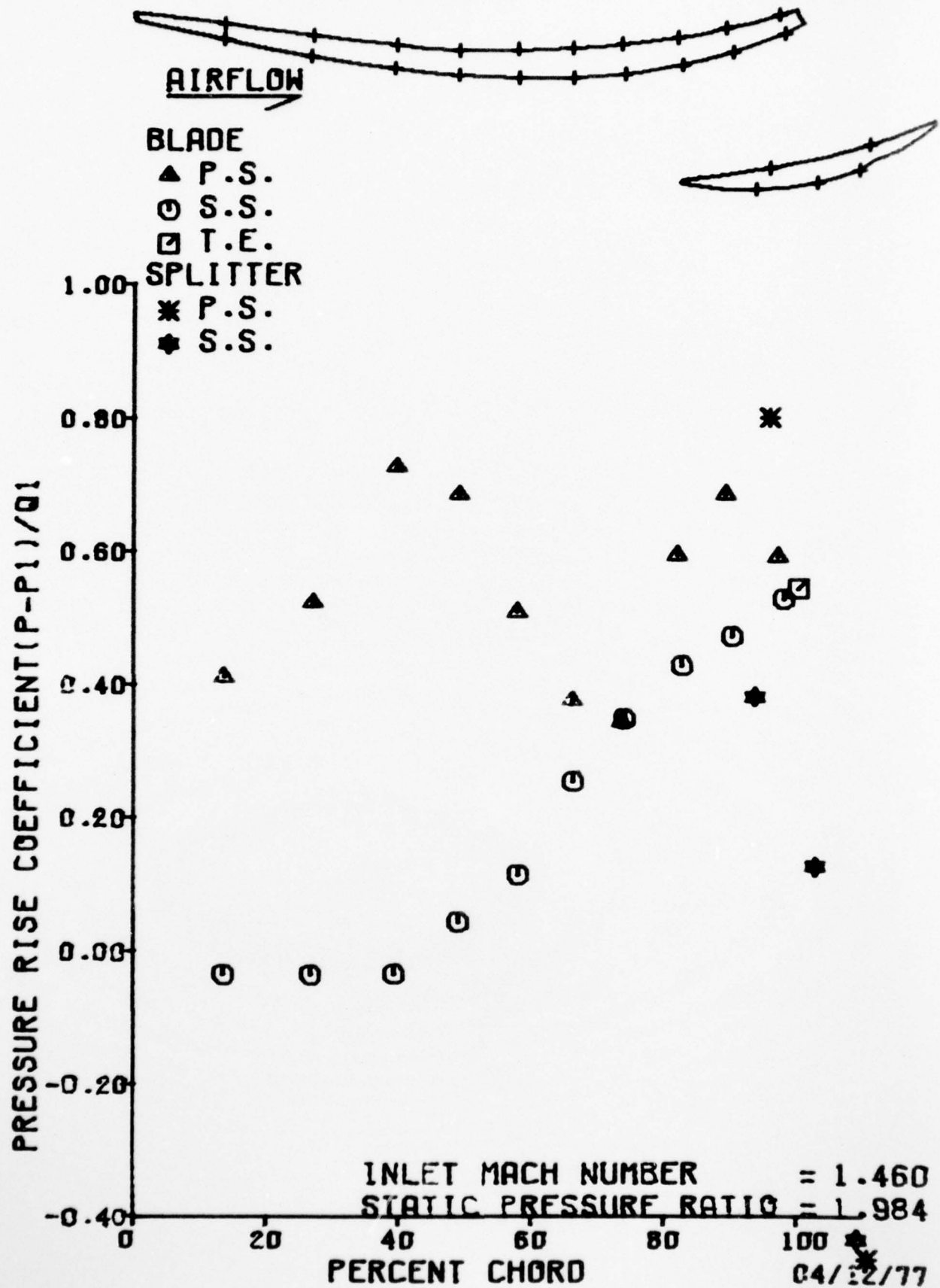
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	OV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
1.984	.636	.586	1.323	.293	1.550	1.280	.230
.054	.585	2.052	.650	1.116	.659	4.854	39.462
22.072	.468						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

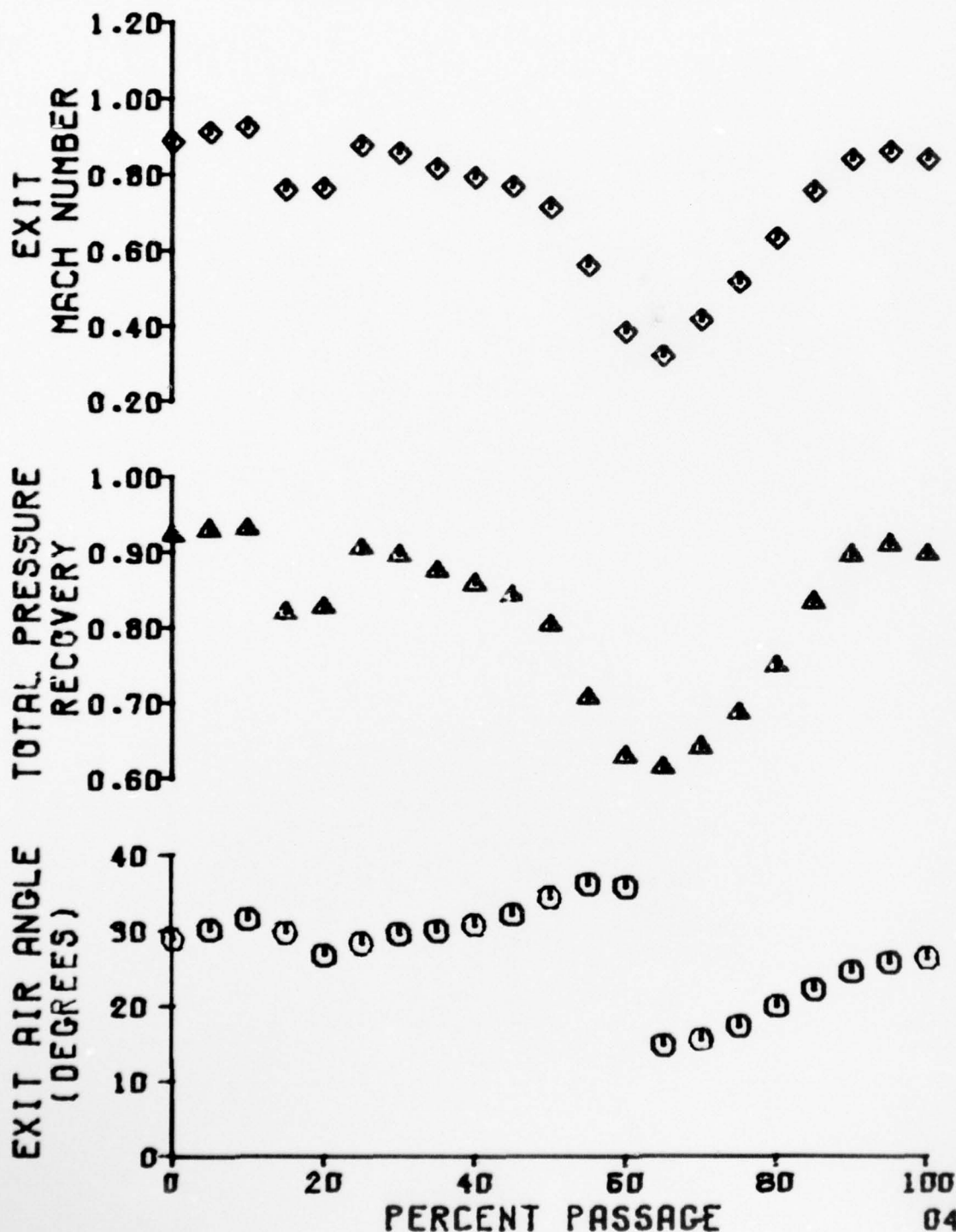
P)2/P)1	PT)2/PT)1	V)2/V)1	V)2/V)1,X	V)2/V)1,Y	R)2/R)1	T)2/T)1	OMEGA
TPLP	DF	DF)EQ	OV)Y	RN)2	DPS/Q1	DEV	TURN
BETA)C	A)2/A)1						
2.047	.617	.544	1.199	.295	1.575	1.300	.257
.059	.527	2.210	.649	1.040	.702	7.350	36.966
10.696	.530						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

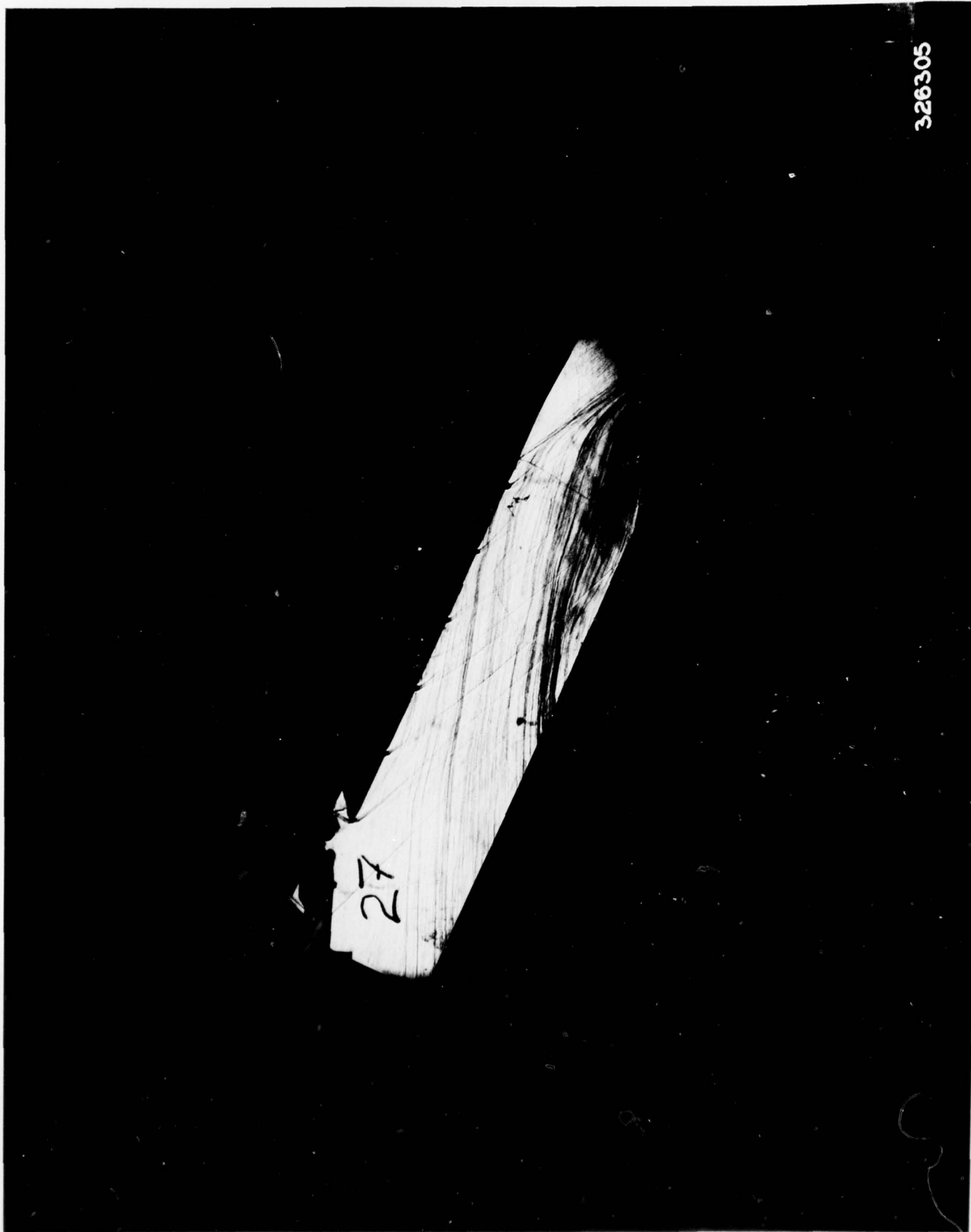


SUPERSONIC COMPRESSOR CASCADE ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 5
AXIAL PROBE LOCATION, INCHES, = 0.490
CASCADE INLET MACH NUMBER = 1.460
CASCADE STATIC PRESSURE RATIO = 1.984



04/12/77



326305

CASCADE INLET SCHLIEREN - MN) 1 = 1.46, P) 2/P) 1 = 1.984

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SPLITTER VANE SETTING ANGLE = 39.75 DEGREES

CASCADE INLET MACH NUMBER	CASCADE IDEAL STATIC PRESSURE RATIO	PROBE DATA TAKEN BEHIND BLADE	PROBE AXIAL LOCATION (IN.)
1.460	1.794	5	.490

MISCELLANEOUS TEST SECTION DATA

PROBE TANGENTIAL POSITION (IN.)	PROBE SPANWISE POSITION (IN.)	PROBE ANGLE (REF. TANG.) (DEG.)	TEST SECTION ANGLE (REF. HORIZ) (DEG.)	TUNNEL TOTAL TEMPERATURE (DEG.R)
8.972	1.501	57.550	24.330	561.079

SUPERSONIC FLOW PROPERTIES ACROSS LEADING WEDGE

NOZZLE EXIT MACH NO.	+ COMPRESSION - EXPANSION OF FLOW	WAVE ANGLE	DOWNSTREAM MACH NUMBER	TOTAL PRESSURE RATIO	STATIC PRESSURE RATIO
1.000	1.180	43.117	1.460	1.000	1.060

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PRESSURE DATA FROM SCANIVALVE - PSIA

AL (IN.)	SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE NO. 2	SCANIVALVE NO. 4	SCANIVALVE NO. 1
	9	20.519	20.512	20.513	20.501
	11	18.907	8.778	10.615	11.285
	13	11.876	10.137	11.056	5.754
	15	13.139	10.509	12.412	5.792
	17	12.517	14.498	11.913	7.125
	19	12.069	11.488	10.322	7.905
	21	20.469	10.402	9.179	9.098
	23	10.972	14.498	9.720	9.745
	25	11.128	8.540	11.881	10.231
	27	11.220	12.859	12.429	10.654
	29	11.128	12.865	11.624	11.150
	31	11.009	14.510	11.237	20.493
	33	11.296	11.292	11.228	2.161
	35	11.082	11.263	11.219	2.998
	37	11.029	11.129	11.216	1.633
	39	11.123	14.495	11.278	1.650
	41	11.434	11.901	11.266	1.422
	43	20.487	14.500	13.083	9.240
	45	5.140	20.491	1.821	7.031
	47	20.477	20.467	20.503	2.091

SPLITTER VANE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	VANE CHORD (IN)	T/C RATIO	SPLITTER LOCATION (IN)
39.750	1.185	.045	38%

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GENERAL MOTORS CORP INDIANAPOLIS IND DETROIT DIESEL --ETC F/G 21/5
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AER--ETC(U)
FEB 77 R E RIFFEL, S FLEETER F33615-76-C-2052

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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE PHYSICAL DESIGN PARAMETERS

STAGGER ANGLE (DEG)	CHORD (IN)	BLADE SPACING (IN)	T/C RATIO	EXIT TO INLET SPAN RATIO (BLADE EXIT)	EXIT TO INLET SPAN RATIO (PROBE MEASURING PLANE)
52.315	3.004	1.581	.036	.516	.467

INLET METAL ANGLE			EXIT METAL ANGLE
PS	SS	ML	ML
(DEGREES)			(DEG.)
61.417	65.479	63.448	22.534

NOZZLE EXIT CONDITIONS

MN)0	PT)0	TT)0	M)0	BETA)0
1.500	20.488	561.079	9.273	65.670

CASCADE INLET CONDITIONS

MN)1	PT)1	TT)1	BETA)1	P)1	M)1	Q)1
1.450	20.487	561.079	66.850	5.914	.249	8.821
1)SS	1)ML	MN)X,1	MN)Y,1	TT/T)1	PT/P)1	NR/10**6
1.371	3.402	.574	1.342	1.426	3.464	1.477

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

CASCADE IDEAL PERFORMANCE
BASED ON SIDEWALL STATIC PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 3	SCANIVALVE PORT #	SCANIVALVE NO. 3
23	10.972	33	11.296
25	11.128	35	11.082
27	11.220	37	11.029
29	11.128	39	11.123
31	11.009	41	11.434

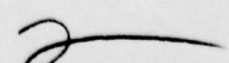
MEAN EXIT STATIC PRESSURE [PSIA]	RMS DEVIATION	MEAN EXIT MID-PASSAGE STATIC PRESSURE [PSIA]	RMS DEVIATION	IDEAL EXIT MACH NO.	CASCADE IDEAL STATIC PRESSURE RATIO (P)2/(P)1
11.092	.090	11.192	.150	.979	1.876

BLADE TRAILING EDGE PRESSURES

PRESSURE DATA FROM SCANIVALVE - PSIA

SCANIVALVE PORT #	SCANIVALVE NO. 4	SCANIVALVE PORT #	SCANIVALVE NO. 4
		31	11.237
		33	11.228
		35	11.219
		37	11.216
		39	11.278
		41	11.266

MEAN TRAILING EDGE PRESSURE [PSIA] 11.240 RMS DEVIATION .023



SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

SIDEWALL BOUNDARY LAYER BLEED PERFORMANCE

NORTH SIDEWALL SLOT PRESSURE	=	2.161 PSIA
SOUTH SIDEWALL SLOT PRESSURE	=	2.998 PSIA
NORTH BLEED MANIFOLD PRESSURE	=	1.633 PSIA
SOUTH BLEED MANIFOLD PRESSURE	=	1.650 PSIA
SIDEWALL BLEED ORIFICE TEMPERATURE	=	550.390 R
SIDEWALL BLEED ORIFICE PRESSURE	=	1.422 PSIA
SIDEWALL BLEED ORIFICE DELTA P	=	.050 PSIA
SIDEWALL BOUNDARY LAYER BLEED FLOW RATE	=	.276 LB/SEC
RATIO OF BLEED TO INLET MASS FLOW RATE	=	.065

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459

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

INSTRUMENTED BLADE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
11	10.615	5.754	.533	-.018	.513	.281	13.69	13.45
13	11.056	5.754	.583	-.016	.540	.281	26.98	26.63
15	12.412	5.792	.737	-.014	.606	.283	39.60	39.24
17	11.913	7.125	.690	.137	.581	.348	49.07	48.78
19	10.322	7.905	.500	.226	.504	.386	57.88	57.75
21	9.179	9.098	.370	.361	.448	.444	66.00	66.09
23	9.720	9.745	.432	.434	.474	.476	73.41	73.77
25	11.861	10.231	.676	.489	.580	.499	81.70	82.41
27	12.429	10.654	.739	.537	.607	.520	89.05	89.97
29	11.624	11.150	.647	.594	.567	.544	96.93	97.73
0	11.247	11.247	.605	.605	.549	.549	100.00	100.00

FC	FC)X	FC)Y	BETA)F	CD)1	CL)1	MC)LE	CP)LE
.340	-.291	.167	-32.736	-.030	.345	.113	32.634

SPLITTER VANE PARAMETERS

	PRESSURE SURFACE (PS)	SUCTION SURFACE (SS)	DPS/Q1 (PS)	DPS/Q1 (SS)	PS/PT)1	SS/PT)1	PERCENT CHORD (PS)	PERCENT CHORD (SS)
43	13.063	9.240	.813	.377	.639	.451	95.57	93.37
45	1.821	7.031	-.464	.127	.089	.343	110.63	102.50
47		2.091		-.433		.102		109.00



18531

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

PERCT	Y DEV PT)YP	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1
.00	7.391 6.157 18.234	.615 38.159 11.674	.715 .000 12.543	.391 2.253 12.049	18.234 889.381 12.159	11.780 20.503 -3.759	.890 20.482 20.492	28.691 20.493 560.734
5.00	7.470 6.966 18.330	.620 37.328 11.695	.714 .027 12.421	.404 2.158 12.082	18.330 894.267 12.208	11.781 20.513 -2.928	.895 20.491 20.501	29.522 20.502 560.734
9.99	7.549 8.199 18.013	.610 36.117 11.913	.696 .027 12.212	.414 2.474 12.003	18.013 884.239 12.167	11.700 20.540 -1.717	.879 20.498 20.518	30.733 20.519 560.734
14.99	7.626 4.862 15.986	.666 39.454 11.817	.592 .025 12.422	.307 4.501 11.816	15.986 741.553 11.914	11.868 20.512 -5.054	.780 20.459 20.485	27.396 20.486 560.734
19.99	7.707 4.040 17.343	.757 40.276 11.724	.677 .024 12.628	.339 3.144 12.020	17.343 832.445 11.991	11.864 20.509 -5.876	.847 20.479 20.493	26.574 20.494 560.734
24.98	7.766 5.797 18.396	.820 38.519 11.826	.722 .027 12.567	.389 2.091 12.217	18.396 894.267 12.179	11.824 20.492 -4.119	.898 20.449 20.470	28.331 20.470 560.734
29.98	7.866 6.951 18.273	.808 37.365 11.980	.704 .028 12.502	.398 2.214 12.292	18.273 882.798 12.258	11.887 20.505 -2.965	.892 20.476 20.490	29.485 20.491 560.734

094

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

LOCAL CASCADE EXIT PERFORMANCE

Y DEV PT)Y	PERCT	MN)2 TURN P)TP	MN)X,2 M)2 P)BP	MN)Y,2 DP)1,2 P)NP	PT)2 V)2 P)SP	P)2 PT)0 BETA)P	PT)2/PT)1 PT)0 PT)1	BETA)2 PT)0,A TT)1	
.691 .493 .734	35.04	7.945 7.336 17.908	.779 36.980 12.037	.676 .027 12.463	.388 2.579 12.355	17.908 854.329 12.274	11.991 20.524 -2.580	.874 20.482 20.502	29.870 20.503 560.734
.522 .502 .734	40.04	8.024 8.022 17.576	.759 36.294 12.069	.653 .025 12.366	.386 2.911 12.424	17.576 834.367 12.265	12.001 20.518 -1.894	.858 20.477 20.497	30.556 20.498 560.734
.733 .519 .734	45.04	8.163 9.421 17.109	.717 34.895 12.131	.608 .025 12.202	.380 3.378 12.354	17.109 792.870 12.310	12.146 20.522 -.495	.835 20.465 20.493	31.955 20.493 560.390
.396 .486 .734	50.03	8.182 11.639 16.240	.660 32.677 12.218	.546 .022 12.011	.371 4.247 12.499	16.240 734.601 12.301	12.127 20.506 1.723	.793 20.455 20.480	34.173 20.480 560.734
.574 .494 .734	55.03	8.261 14.089 14.449	.513 30.227 12.300	.412 .018 12.003	.306 6.039 12.169	14.449 580.346 12.185	12.076 20.516 4.173	.705 20.491 20.503	36.623 20.504 560.734
.331 .470 .734	60.03	8.340 15.433 13.133	.352 28.083 12.219	.276 .013 12.065	.217 7.354 11.971	13.133 404.249 12.077	12.052 20.521 5.517	.641 20.464 20.492	37.967 20.493 560.734

485
491
734

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

65.02	8.419 35.636 12.752	.289 8.866 12.038	.110 .007 12.166	.178 7.725 11.925	12.762 241.677 12.061	12.379 20.498 25.734	.623 20.442 20.469	58.184 20.470 560.390
70.02	8.498 -5.229 13.079	.345 49.545 11.899	.330 .008 12.292	.103 7.408 11.921	13.079 396.251 12.084	12.044 20.519 -15.145	.638 20.498 20.508	17.305 20.508 560.734
75.02	8.577 -3.071 13.608	.429 47.987 11.791	.405 .014 12.428	.139 6.880 11.944	13.608 489.447 12.000	11.989 20.511 -13.587	.664 20.515 20.513	18.863 20.513 560.390
80.01	8.656 -2.030 14.455	.515 46.946 11.754	.484 .017 12.649	.175 6.032 12.050	14.455 582.315 11.944	12.066 20.509 -12.546	.706 20.491 20.500	19.904 20.500 560.390
85.01	8.735 -1.106 15.721	.625 45.424 11.734	.581 .020 12.915	.228 4.766 12.111	15.721 698.437 11.897	12.086 20.524 -11.024	.767 20.489 20.506	21.426 20.507 560.734
90.01	8.814 .415 17.368	.735 43.900 11.757	.677 .024 13.166	.287 3.119 12.287	17.368 810.534 11.916	12.130 20.513 -9.500	.848 20.475 20.493	22.950 20.494 560.390
95.00	8.893 2.175 18.489	.808 42.141 11.838	.734 .028 13.215	.338 1.998 12.473	18.489 882.281 12.004	12.034 20.516 -7.741	.902 20.467 20.491	24.709 20.492 560.734
100.00	8.972 3.395 18.832	.834 40.921 11.874	.750 .029 13.098	.365 1.655 12.526	18.832 905.953 12.069	11.942 20.501 -6.521	.919 20.479 20.489	25.929 20.490 560.734

18581

461

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

MASS AVERAGED EXIT CONDITIONS

MN)2 BETA)2 PT)2/PT)1

.704 28.005 .827

CASCADE EXIT PARAMETERS
BASED ON MASS AVERAGED CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	M)2/M)1
.622	.331	16.936	12.164	561.079	1.099	.821

MIXED EXIT CONDITIONS

MN)X,2	MN)Y,2	PT)2	P)2	TT)2	TT)2/T)2	MN)2	BETA)2
.541	.325	16.570	12.674	561.079	1.080	.631	31.024

2

SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

OVERALL PERFORMANCE

MASS AVERAGED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
2.057	.827	.549	1.234	.281	1.585	1.298	.244
.057	.625	2.190	.661	1.058	.709	5.471	38.845
15.025	.511						

OVERALL PERFORMANCE

MIXED EXIT CONDITIONS

P)2/P)1 TPLP BETA)C	PT)2/PT)1 DF A)2/A)1	V)2/V)1 DF)EQ	V)2/V)1,X DV)Y	V)2/V)1,Y RN)2	R)2/R)1 DPS/Q1	T)2/T)1 DEV	OMEGA TURN
2.143	.809	.497	1.083	.278	1.622	1.321	.269
.001	.678	2.424	.663	.966	.766	8.492	35.826
.000	.569						

ARL STREAMLINE NO.10 - 3 TO 1 STAGE

AIRFLOW

BLADE

▲ P.S.

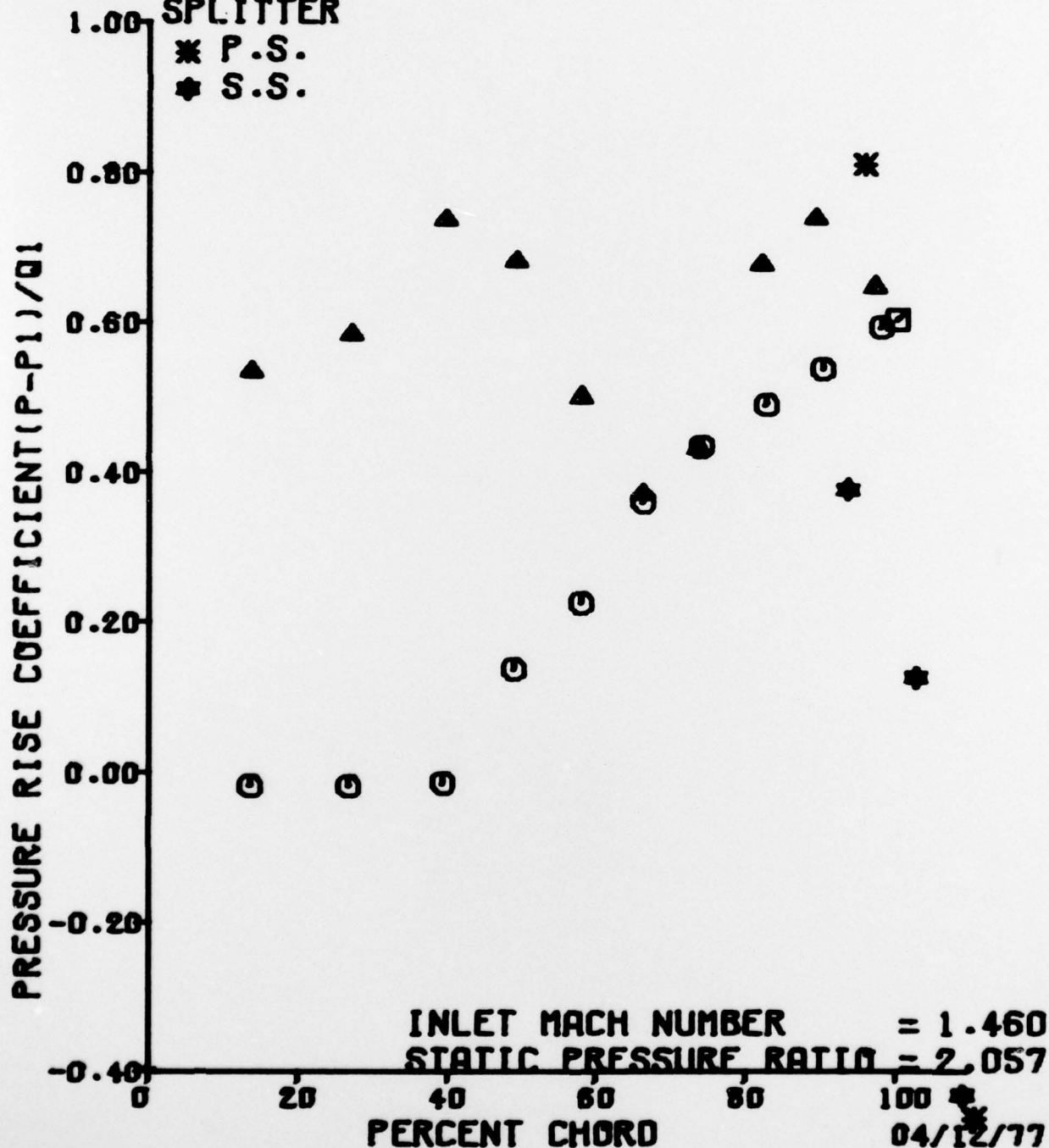
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SPLITTER

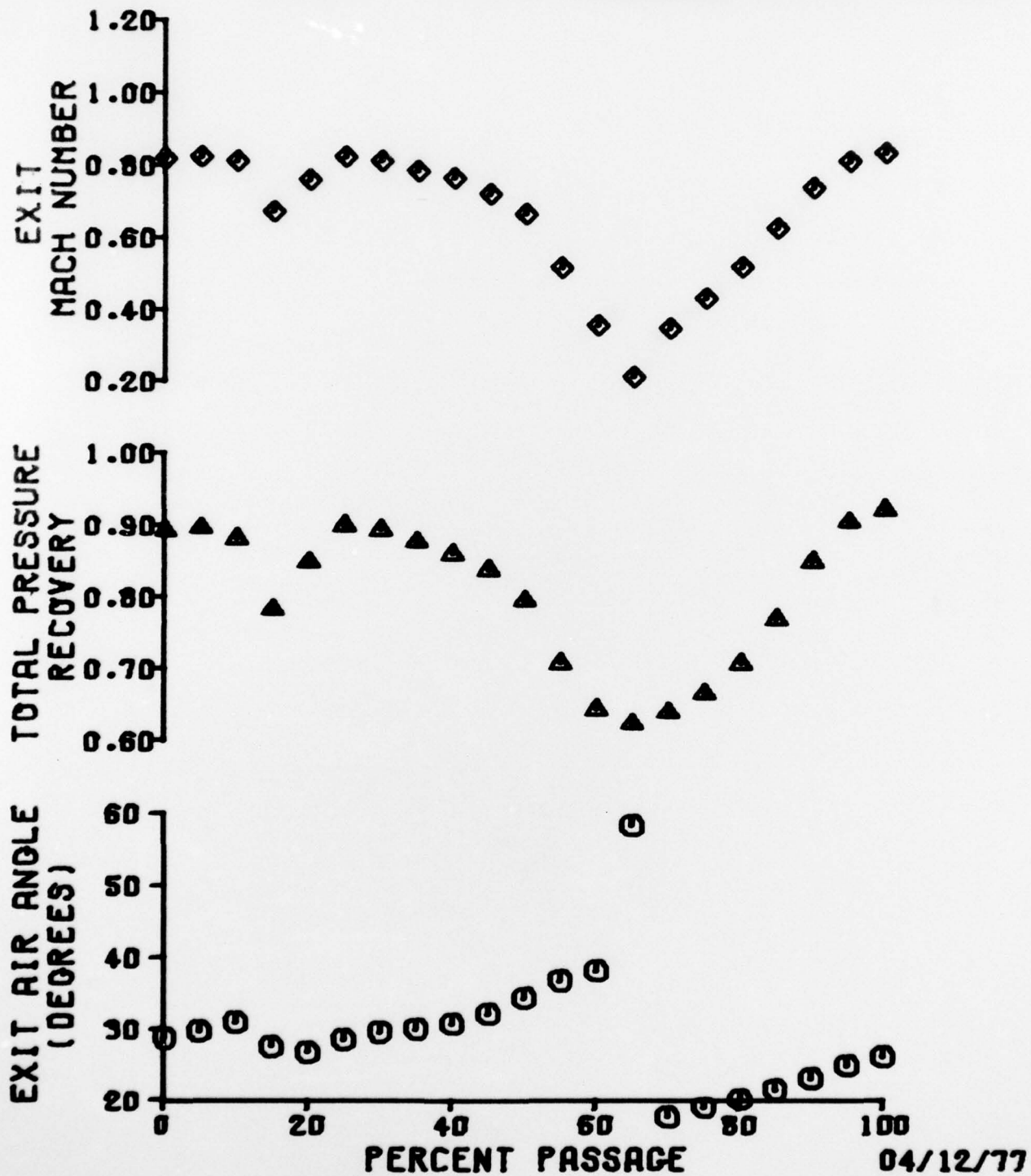
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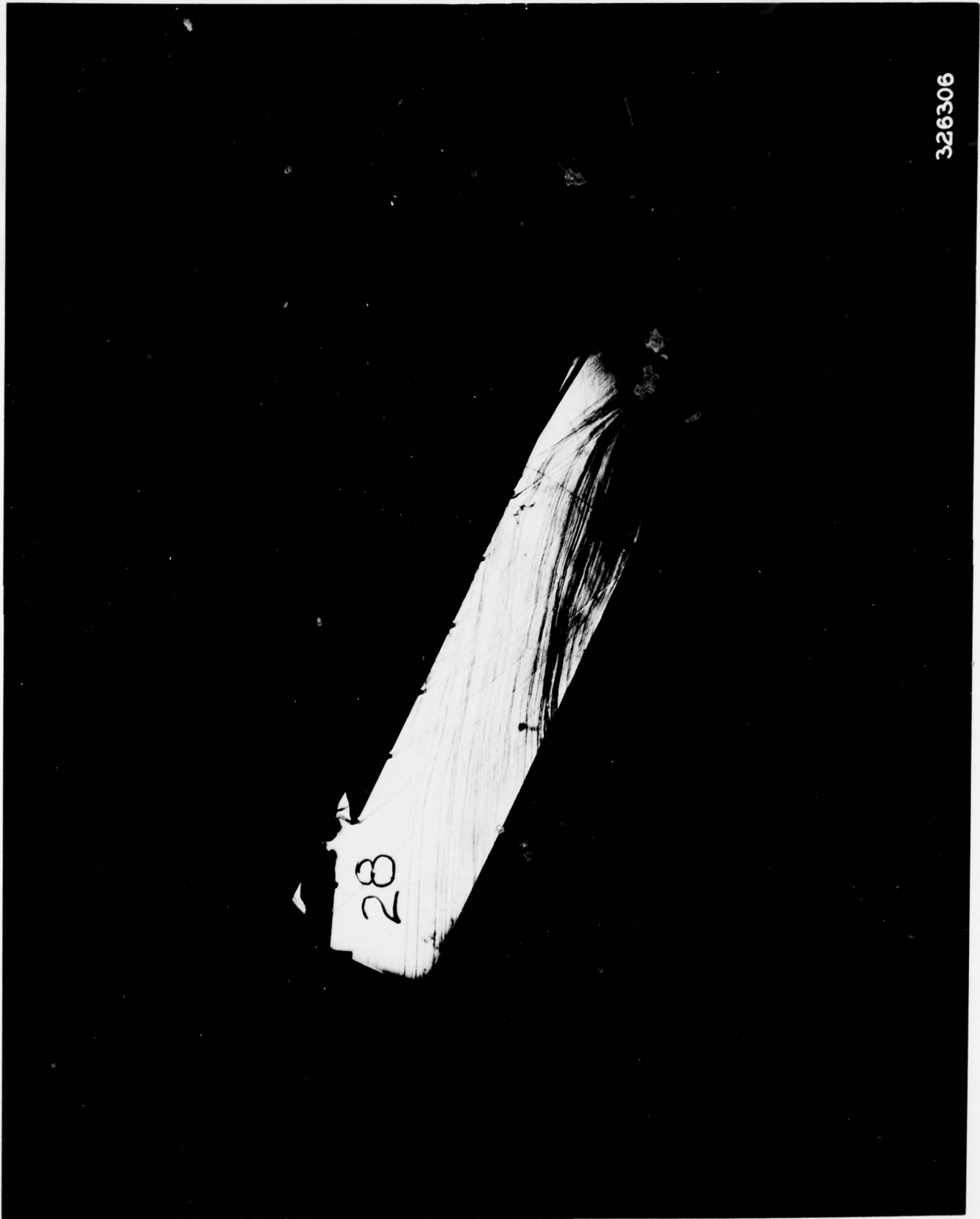
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SUPERSONIC COMPRESSOR CASCADE
ARL STREAMLINE NO.10 - 3 TO 1 STAGE

PROBE TRAVERSE BEHIND BLADE NO. 5
AXIAL PROBE LOCATION, INCHES, ≈ 0.490
CASCADE INLET MACH NUMBER ≈ 1.460
CASCADE STATIC PRESSURE RATIO ≈ 2.057





326306

CASCADE INLET SCHLIEREN - MN) I = 1.46, P)2/P) I = 2.057

REFERENCES

1. Wennerstrom, A. J., Buzzell, W. A. and DeRose, R. D., "Test of a Supersonic Axial Compressor Stage Incorporating Splitter Vanes in the Rotor," ARL 75-0165, ADA014732, Aerospace Research Laboratories, WPAFB, Ohio, June 1975.
2. Holtman, R. L., McClure, R. B., and Sinnet, G. T., "Test of a Supersonic Compressor Cascade with Splitter Vanes", ARL 73-0142, AD774549, Aerospace Research Laboratories, WPAFB, Ohio.
3. Holtman, R. L., McClure, R. B., and Sinnet, G. T., "Test of a Supersonic Compressor Cascade with Splitter Vanes and Vortex Generators on Blades", ARL 73-0141, AD774454, Aerospace Research Laboratories, WPAFB, Ohio.
4. Holtman, R. L., Huffman, G. D., McClure, R. B., Sinnet, G. T., "Test of a Supersonic Compressor Cascade", Volumes I and II, ARL 72-0170, AD756870, AD756871, December 1972.
5. Erwin, J. R. and Emery, J. C., "Effect of Tunnel Configuration and Testing Technique on Cascade Performance", NACA Report 1016, November 1949.
6. "Equations, Tables, and Charts for Compressible Flow", NACA Report 1135, Ames Research Center, 1953.
7. York, R. E., "A Conical Probe for Determining Flow Field Parameters", Detroit Diesel Allison RN 69-10, February 1969.
8. Huffman, G. D., "An Analysis of Flow Mixing Following Airfoil Cascades", Detroit Diesel Allison RN 71-78, December 1971.

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